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Environmental Impact Statement/Overseas Environmental Impact Statement

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NWTT EIS/OEIS Project Manager
Naval Facilities Engineering Command, Northwest, EV21.KK
1101 Tautog Circle
Silverdale, WA 98315

3.7 Marine Vegetation

TABLE OF CONTENTS

3.7 MARINE VEGETATION 3.7-1
3.7.1 INTRODUCTION 3.7-1
3.7.2 AFFECTED ENVIRONMENT 3.7-3
3.7.2.1 General Threats 3.7-3
3.7.2.2 Marine Vegetation Groups and Distribution 3.7-4
3.7.3 ENVIRONMENTAL CONSEQUENCES 3.7-12
3.7.3.1 Acoustic Stressors 3.7-12
3.7.3.2 Physical Disturbance and Strike Stressors 3.7-17
3.7.3.3 Secondary Stressors 3.7-34
3.7.3.4 Summary of Potential Impacts (Combined Impacts of All Stressors) on Marine Vegetation 3.7-34

LIST OF TABLES

TABLE 3.7-1: MAJOR TAXONOMIC GROUPS OF MARINE VEGETATION IN THE STUDY AREA 3.7-2
TABLE 3.7-2: STRESSORS FOR MARINE VEGETATION IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.7-13

LIST OF FIGURES

FIGURE 3.7-1: CHLOROPHYLL *A* CONCENTRATIONS IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.7-6
FIGURE 3.7-2: KELP AND *SARGASSUM* IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.7-9
FIGURE 3.7-3: SURFGRASS AND EELGRASS IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.7-11

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3.7 MARINE VEGETATION

MARINE VEGETATION SYNOPSIS

The United States Department of the Navy considered all potential stressors, and the following have been analyzed for marine vegetation:

- Acoustic (underwater explosives)
- Physical disturbance and strike (vessel and in-water device strikes, military expended materials, and seafloor devices)

Preferred Alternative (Alternative 1)

- No Endangered Species Act-listed marine vegetation species are found in the Northwest Training and Testing Study Area.
- Acoustic and Physical Disturbance and Strike: Underwater explosives and physical disturbance and strike could affect marine vegetation by destroying individual plants or damaging parts of plants. The impacts of these stressors are not expected to result in detectable changes in growth, survival, or propagation, and are not expected to result in population-level impacts on marine plant species.
- Secondary: Secondary stressors are not expected to result in detectable changes in growth, survival, propagation, or population-level impacts because changes in sediment and water quality or air quality are not likely to be detectable.
- These conclusions are based on the fact that the areas of impact are very small compared to the relative distribution and the locations where explosions or physical disturbance or strikes occur.
- Pursuant to the Essential Fish Habitat (EFH) requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives and other impulse sources, vessel movement, in-water devices, military expended materials, and seafloor devices during training and testing activities may have an adverse effect on EFH by reducing the quality and quantity of marine vegetation that constitutes EFH or Habitat Areas of Particular Concern.

3.7.1 INTRODUCTION

This section analyzes potential impacts on marine vegetation found in the Northwest Training and Testing (NWTT) Study Area (Study Area). Pierside maintenance and testing that would occur in the Offshore Area, Inland Waters (Puget Sound), and in Southeast Alaska (Behm Canal), would not create stressors affecting marine vegetation and, therefore, pierside maintenance and testing are not addressed in this section. Marine vegetation, including marine algae and flowering plants, are found throughout the Study Area. No Endangered Species Act (ESA)-listed species are found in the Study Area. United States (U.S.) Department of the Navy (Navy) training and testing activities are evaluated for their potential impacts on six major taxonomic groups of marine vegetation, as appropriate (Table 3.7-1).

Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act will be described in the Essential Fish Habitat Assessment (EFHA), and conclusions from the EFHA will be summarized in each substressor section.

The distribution and condition of offshore abiotic (non-living) substrates associated with attached macroalgae and the impact of stressors on those substrates are described in Section 3.3 (Marine Habitats).

Additional information on the biology, life history, and conservation of marine vegetation can be found on the websites of the following agencies and groups:

- National Marine Fisheries Service, Office of Protected Resources (including ESA-listed species distribution maps)
- Conservation International
- Algaebase
- National Resources Conservation Service
- National Museum of Natural History

The marine vegetation found in the Study Area consists of five groups of marine algae and one group of flowering plants (Table 3.7-1). More information on each of the major taxonomic groups is provided in the offshore, inshore, and southeast Alaska section discussions in Section 3.7.2 (Affected Environment).

Table 3.7-1: Major Taxonomic Groups of Marine Vegetation in the Study Area

Marine Vegetation Groups[1]		Distribution in the Study Area[2]		
Common Name (Taxonomic Group)	**Description**	**Offshore Area**	**Inland Waters**	**Western Behm Canal (Alaska)**
Dinoflagellates (phylum Dinophyta)	Most are photosynthetic single-celled algae that have two whip-like appendages (flagella); Some live inside other organisms. Some produce toxins that can result in red tides or ciguatera poisoning.	Sea surface	Sea surface	Sea surface
Blue-green algae (phylum Cyanobacteria)	Many form mats that attach to reefs and produce nutrients for other marine species through nitrogen fixation.	Sea surface	Seafloor	Seafloor
Green algae (phylum Chlorophyta)	Marine species occur as unicellular algae, filaments, and large seaweeds.	None	Sea surface, seafloor	Sea surface, seafloor
Diatoms, brown and golden-brown algae (phylum Heterokontophyta)	Single-celled algae that form the base of the marine food web; brown and golden-brown algae are large multi-celled seaweeds that form extensive canopies, providing habitat and food for many marine species.	Sea surface	Sea surface, seafloor	Sea surface, seafloor
Red algae (phylum Rhodophyta)	Single-celled algae and multi-celled large seaweeds; some form calcium deposits.	Sea surface	Seafloor	Seafloor
Seagrass and cordgrass (phylum Spermatophyta)	Flowering plants are adapted to salty marine environments in mudflats and marshes, providing habitat and food for many marine species.	None	Seafloor	Seafloor

[1] Species groups are based on the Catalogue of Life (Bisby et al. 2010).
[2] "None" indicates absence of the taxonomic group within the Study Area portion (see map of the Study Area in Figure 2.1-1).

3.7.2 AFFECTED ENVIRONMENT

Factors that influence the distribution and abundance of vegetation in the large marine ecosystems and open ocean areas of the Study Area are the availability of light, nutrients, water quality, water clarity, salinity level, seafloor type (important for rooted or attached vegetation), currents, tidal schedule, and temperature (Green and Short 2003). Marine ecosystems in the Study Area depend almost entirely on the energy produced by photosynthesis of marine plants and algae (Castro and Huber 2000), which is the transformation of the sun's energy into chemical energy. In surface waters of the open ocean and coastal waters, as well as within the portion of the water column illuminated by sunlight, marine algae and flowering plants provide oxygen, food, and habitat for many organisms (Dawes 1998).

Marine vegetation along the Pacific Northwest coast is represented by more than 700 varieties of seaweeds (such as corallines and other red algae, brown algae including kelp, and green algae), seagrasses (Dethier 1990; Berry and Ritter 1995; Wyllie-Echeverria and Ackerman 2003), and canopy-forming kelp species (Eissinger 2009). Red algae are the most diverse of the macroalgae in the Pacific Northwest, based on number of genera (about 115) and species (at least 265) (Waaland 1977). In intertidal and shallow subtidal areas, red algae often occupy the understory of the larger kelp. Green algae are the second most common vegetation in the intertidal areas of the Strait of Juan de Fuca (Bailey et al. 1998). Brown algae, such as the kelp beds in the Pacific Northwest, are among the most extensive and elaborate in the world. Kelp beds extend into the Strait of Juan de Fuca to Crescent Rock; however, they are uncommon in Dabob Bay and northern Hood Canal. In the Behm Canal near the Southeast Alaska Acoustic Measurement Facility (SEAFAC) portion of the Study Area, the marine vegetation mainly occurs in the near coastal waters around Back Island and includes green, brown, and red algae on rocky substrates, and some eelgrass on sandy substrates (U.S. Department of the Navy 1988). The rest of the SEAFAC area is composed of soft substrate outside of the photic zone and therefore lacks marine vegetation.

Certain species of microscopic algae (dinoflagellates and diatoms, for example) can form algal blooms, which can be toxic to human health and wildlife species. Harmful algal blooms can deplete oxygen within the water column and block sunlight that other organisms need to live, and some algae within algal blooms release toxins that are dangerous to human and ecological health (Center for Disease Control and Prevention 2004). These algal blooms have a negative economic impact of hundreds of millions of dollars annually world-wide (National Centers for Coastal Ocean Science 2010) with significant losses incurred by closed commercial fisheries and the public health costs of illnesses.

The marine vegetation in the taxonomic groups of seagrass and cordgrass has more limited distributions; none occur in open ocean areas. The relative distribution of seagrass is influenced by the availability of suitable substrate in low-wave-energy areas at depths that allow sufficient light exposure. Cordgrasses form dense colonies in salt marshes that develop in temperate areas in protected, low-energy environments, along the intertidal portions of coastal lagoons, tidal creeks or rivers, or estuaries, wherever the sediment can support plant root development (Mitsch et al. 2009).

3.7.2.1 General Threats

Stressors on marine vegetation are products of human activities (industrial, residential, and recreational) and natural occurrences such as storms. Species-specific information is discussed, where applicable, in Section 3.7.2.2 (Marine Vegetation Groups and Distribution), and the cumulative impacts of these threats are analyzed in Chapter 4 (Cumulative Impacts).

Human-made stressors that act on marine vegetation include excessive nutrient input (fertilizers, etc.), siltation (the addition of fine particles to the ocean), pollution (oil, sewage, trash), climate change, overfishing (Mitsch et al. 2009, Steneck et al. 2002), shading from structures (National Marine Fisheries Service 2002), habitat degradation from construction and dredging (National Marine Fisheries Service 2002), and invasion by exotic species (Hemminga and Duarte 2000, Spalding et al. 2003). The seagrass, and cordgrass taxonomic group is more sensitive to stressors than the algal taxonomic groups. The great diversity of algae makes generalization difficult but, overall, algae are resilient and colonize disturbed environments (Levinton 2009b).

Seagrasses and cordgrasses are all susceptible to the human-made stressors on marine vegetation, and their presence in the Study Area has decreased because of these stressors. Each of these types of vegetation is sensitive to additional unique stressors. Seagrasses are uprooted by dredging and scarred by boat propellers (Hemminga and Duarte 2000, Spalding et al. 2003). Seagrass beds that are scarred from boat propellers can take years to recover. Cordgrasses are damaged by sinking salt marsh habitat, a process known as marsh subsidence.

Oil in runoff from land-based sources, natural seeps, and accidental spills (such as offshore drilling and oil tanker leaks) is a major source of pollution in the marine environment (Levinton 2009a). The types and amounts of oil spilled, weather conditions, season, location, oceanographic conditions, and the method used to remove the oil (containment or chemical dispersants) are some of the factors that determine the severity of the effects. Sensitivity to oil varies among marine vegetation species and within species, depending on the life stage; generally, early-life stages are more sensitive than adult stages (Hayes et al. 1992).

Oil pollution can impact seagrasses directly by smothering the plants, or indirectly by lowering their ability to combat disease and other stressors (U.S. National Response Team 2010). Seagrasses that are totally submerged are less susceptible to oil spills because they largely escape direct contact with the pollutant. Depending on various factors, oil spills such as the Gulf War oil spill in 1991 (Kenworthy et al. 1993) range from no impact on seagrasses to long-term impacts, such as the 4-year decrease in eelgrass density caused by the *Exxon Valdez* oil spill in 1989 (Peterson 2001). Algae are relatively resilient to oil spills. Salt marshes can also be severely impacted by oil spills, and the effects can be long term (Culbertson et al. 2008).

3.7.2.2 Marine Vegetation Groups and Distribution

3.7.2.2.1 Dinoflagellates (Phylum Dinophyta)

Dinoflagellates are single-celled organisms with two flagella (whiplike structures used for locomotion) in the phylum Dinophyta (Bisby et al. 2010). Dinoflagellates are predominantly marine algae, with an estimated 1,200 species living in surface waters of the ocean worldwide (Castro and Huber 2000). Most dinoflagellates can use the sun's energy to produce food through photosynthesis and also can ingest small food particles. Photosynthetic dinoflagellates are important primary producers in coastal waters (Waggoner and Speer 1998). Organisms such as zooplankton (microscopic animals that drift passively in the water column), feed on dinoflagellates. In the oceanic system, dinoflagellates utilize a suite of light harvesting compounds to convert solar energy into chemical energy, the most common being Chlorophyll *a*. Rates of photosynthetic production can vary from between less than 0.1 gram of carbon (gC)/square meter (m^2)/day in less productive regions, such as the western equatorial Pacific, to more than 10 gC/m^2/day in highly productive areas (Thurman 1997).

Dinoflagellates cause some types of harmful algal blooms which result from sudden increases in nutrients (e.g., fertilizers) from land into the ocean or changes in temperature and sunlight (Levinton 2009c). About 75–80 percent of toxic phytoplankton species are dinoflagellates (Cembella 2003) and are known to cause harmful algal blooms. Harmful algal blooms often kill fish and shellfish either directly, because of toxin production, or because of effects caused by large numbers of cells that clog the animal's gills and deplete them of oxygen (Smayda 1997). When affected shellfish or fish are eaten by humans, they cause diseases like paralytic shellfish poisoning, neurotoxic shellfish poisoning, diarrheic shellfish poisoning, and ciguatera (Lehane and Lewis 2000). Additional information on harmful algal blooms can be accessed on the Centers for Disease Control and the National Oceanic and Atmospheric Administration websites.

3.7.2.2.1.1 Offshore Area

The coast of the Pacific Northwest supports high primary productivity (Sutor et al. 2005). Because most dinoflagellates are photosynthetic and use Chlorophyll *a* to undergo the photosynthetic process, concentrations of Chlorophyll *a* measured in the Offshore Area can indicate the presence and population density of dinoflagellates. Concentrations greater than 3.0 milligrams of chlorophyll per cubic meter (mg chl/m^3) are present throughout the spring, summer, and fall within 40 kilometers (km) of shore, and rarely expand beyond 100 km offshore (Thomas and Strub 2001). Lowest concentrations (< 0.25 mg chl/m^3) are usually located over 200 km offshore and intrude towards the coast in mid-summer (June–July). Each year, two blooms occur, one in spring and another in summer. The timing of the first bloom varies, occurring from early April to May. The second offshore expansion typically occurs in August (Thomas and Strub 2001). Dinoflagellates produce some of the Chlorophyll *a* detected in the Offshore Area (Figure 3.7-1). The distribution of dinoflagellates depends on factors such as light intensity, salinity, water temperature, currents, topography, nutrients, reproductive cycles, and predators (Richlen and Lobel 2011).

3.7.2.2.1.2 Inland Waters

Most Chlorophyll *a* production in the Inland Waters is detected in the Strait of Juan de Fuca (Figure 3.7-1), which is where the highest concentrations of phytoplankton such as dinoflagellates will occur.

3.7.2.2.1.3 Western Behm Canal, Alaska

A study of sea surface chlorophyll concentrations for southeastern Alaska conducted in 2004 shows increased phytoplankton biomass near the Western Behm Canal portion of the Study Area between June and August (SALMON Project 2004). These late summer blooms of phytoplankton are triggered by wind driven vertical mixing of nutrients (Iverson et al. 1974, Ziemann et al. 1991). Dinoflagellates produce some of the Chlorophyll *a* detected in this portion of the Study Area.

3.7.2.2.2 Blue-Green Algae (Phylum Cyanobacteria)

Blue-green algae are single-celled, photosynthetic bacteria that inhabit the lighted surface waters and seafloors of the world's oceans (Bisby et al. 2010). Blue-green algae are key primary producers in the marine environment, and provide valuable ecosystem services such as producing oxygen and nitrogen. The blue-green algae *Prochlorococcus* is responsible for a large part of the oxygen produced globally by photosynthetic organisms. Other species of blue-green algae have specialized cells that convert nitrogen gas into a form that can be used by other marine plants and animals (nitrogen fixation) (Hayes et al. 2007; Sze 1998).

3.7.2.2.2.1 Offshore Area

The coast of the Pacific Northwest supports high primary productivity (Sutor et al. 2005). Concentrations greater than 3.0 mg chl/m^3 are present throughout the spring, summer, and fall within 40 km of shore, and rarely expand beyond 100 km offshore (Thomas and Strub 2001). Lowest concentrations (< 0.25 mg chl/m^3) are usually located over 200 km offshore and intrude towards the coast in mid-summer (June–July). Each year, two blooms occur, one in spring and another in summer. The timing of the first of these episodes varies, occurring from early April to May. The second offshore expansion typically occurs in August (Thomas and Strub 2001). Blue-green algae produce some of the Chlorophyll *a* detected in the Offshore Area (Figure 3.7-1).

3.7.2.2.2.2 Inland Waters

Most Chlorophyll *a* production in the Inland Waters is detected in the Strait of Juan de Fuca (Figure 3.7-1), which is where the highest concentrations of phytoplankton such as blue-green algae occurs. The inland waters show less variability in Chlorophyll *a* production than the Offshore Area.

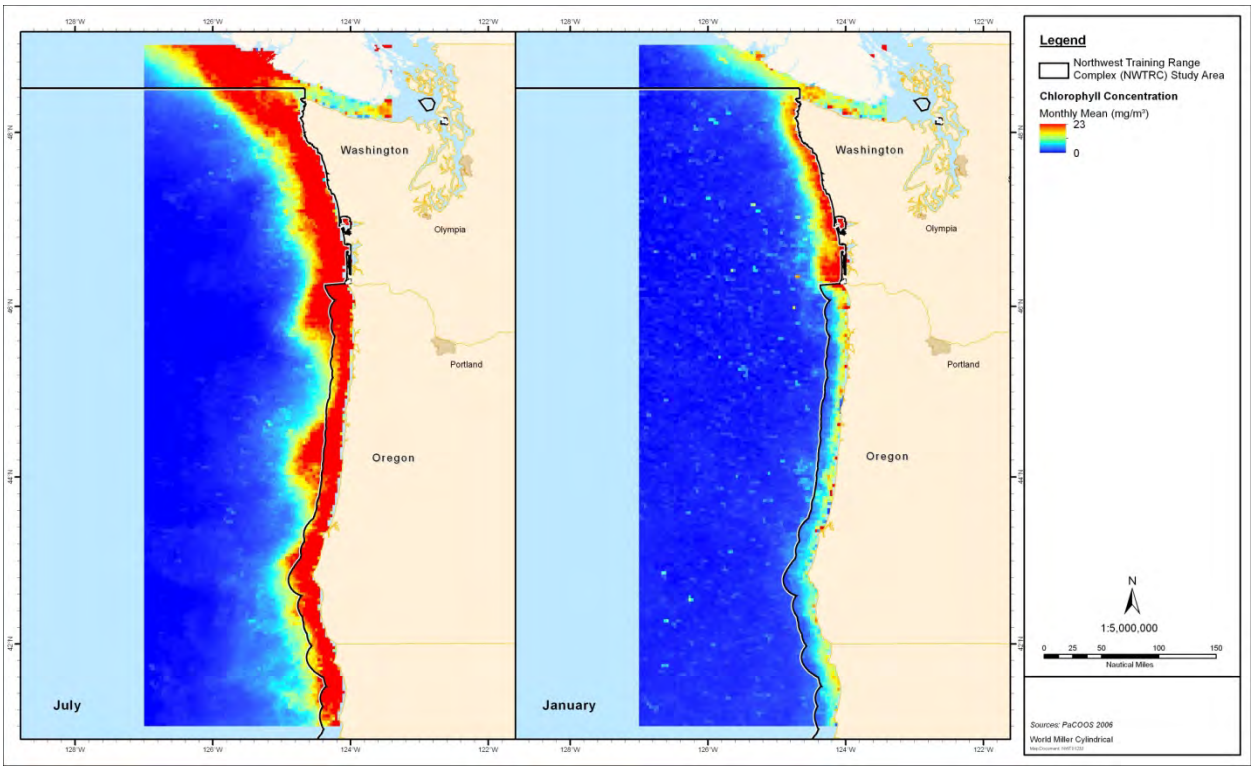

Figure 3.7-1: Chlorophyll *a* Concentrations in the Northwest Training and Testing Study Area

3.7.2.2.2.3 Western Behm Canal, Alaska

A study of sea surface chlorophyll concentrations for southeastern Alaska conducted in 2004 shows increased phytoplankton biomass near the Western Behm Canal portion of the Study Area between June and August (SALMON Project 2004). These late summer blooms of phytoplankton are triggered by wind-driven vertical mixing of nutrients (Iverson et al. 1974, Ziemann et al. 1991). Blue-green algae produce some of the Chlorophyll *a* detected in this portion of the Study Area.

3.7.2.2.3 Green Algae (Phylum Chlorophyta)

Green algae are single-celled organisms in the phylum Chlorophyta that may form large colonies of individual cells (Bisby et al. 2010). Green algae are predominately found in freshwater, with only 10 percent of the estimated 7,000 species living in the marine environment (Castro and Huber 2000). These species are important primary producers that play a key role at the base of the marine food web.

3.7.2.2.3.1 Offshore Area

Green algae are less common in the exposed areas of the outer coast. However, sometimes they are found to occur on the sea surface and sea floor of the Offshore Area (Bailey et al. 1998). Green algae produce some of the Chlorophyll *a* detected in the Offshore Area (see Figure 3.7-1).

3.7.2.2.3.2 Inland Waters

Green algae inhabit the more protected marine and estuarine areas in Washington, primarily in tide pools and rocky intertidal areas. They are the second most common vegetation in the intertidal areas of the Strait of Juan de Fuca (Bailey et al. 1998). The green algae community primarily is in the upper 330 feet (ft.) (100 meters [m]) of the water column. The distribution of phytoplankton depends on factors such as light intensity, salinity, water temperature, currents, topography, nutrients, reproductive cycles, and predators (Smith 1977, Strub et al. 1990, Batchelder et al. 2002). During the spring and summer, the upwelling of nutrient-rich waters into the surface layers combines with high solar radiation and long days to produce huge numbers of these tiny plants (Strub et al. 1990, Batchelder et al. 2002, Perry et al. 1989).

3.7.2.2.3.3 Western Behm Canal, Alaska

A study of sea surface chlorophyll concentrations for southeastern Alaska conducted in 2004 shows increased phytoplankton biomass near the Western Behm Canal portion of the Study Area between June and August (SALMON Project 2004). These late summer blooms of phytoplankton are triggered by wind-driven vertical mixing of nutrients (Iverson et al. 1974, Ziemann et al. 1991). Green algae produce some of the Chlorophyll *a* detected in this portion of the Study Area. In addition to single cellular green algae, there are various species of green macroalgae in this portion of the Study Area, such as *Acrosiphonia mertensii*, *Enteromorpha linza*, and *Cladophora columbiana* (Guiry and Guiry 2013).

3.7.2.2.4 Brown Algae (Phylum Heterokontophyta)

Brown and golden-brown algae can be single-celled (diatoms) or large, multi-celled species with structures varying from filamentous to thick, leathery forms.

3.7.2.2.4.1 Diatoms

Diatoms are single-celled organisms with cell walls made of silicon dioxide. Two major groups of diatoms are generally recognized, centric diatoms and pennate diatoms. Centric diatoms exhibit radial symmetry (symmetry about a point), while the pennate diatoms are bilaterally symmetrical (symmetry about a line). Diatoms such as *Coscinodiscus* species (spp.) commonly occur in the Study Area. Some strains of another genus of diatoms, *Pseudo-nitzschia*, produce a toxic compound called domoic acid. Humans, marine mammals, and seabirds become sick or die when they eat organisms that feed on *Pseudo-nitzschia* strains that produce the toxic compound. Strains of another genus of diatoms, *Alexandrium*, produce a toxic bloom causing paralytic shellfish poisoning. Blooms that result in catastrophic losses of cultured and wild fish, but do not cause illness in humans are caused by a few species of the diatom genus *Chaetoceros*, which clogs fish gills (Boesch et al. 1997). Decreases in the movement of cool, nutrient-rich waters by the wind in combination with pollutants carried from land to

the ocean by rainwater are believed to be the main causes of these harmful algal blooms in the Study Area (Kudela and Cochlan 2000). Researchers in the Olympic coastal region, which occurs in the Study Area, are testing the hypothesis that these harmful algal bloom events affecting coastal communities are largely caused by toxic algal species growing in the vicinity of the Juan de Fuca eddy which are transported to nearshore waters by storms (National Oceanic and Atmospheric Administration 2013).

Offshore Area

The diatom community primarily is in the upper 330 ft. (100 m) of the water column (Walsh et al. 1977, Estrada and Blasco 1979, Hardy 1993). The distribution of diatoms depends on factors such as light intensity, salinity, water temperature, currents, topography, nutrients, reproductive cycles, and predators (Smith 1977, Strub et al. 1990, Batchelder et al. 2002). The coast of the Pacific Northwest supports a high density of diatoms (Sutor et al. 2005). During the spring and summer, the upwelling of nutrient-rich waters into the surface layers combines with high solar radiation and long days to produce huge numbers of these tiny cells (Strub et al. 1990, Batchelder et al. 2002, Perry et al. 1989).

Inland Waters

Most Chlorophyll *a* production in the Inland Waters is detected in the Strait of Juan de Fuca (see Figure 3.7-1), which is where the highest concentrations of phytoplankton such as diatoms will occur.

Western Behm Canal, Alaska

Diatoms are known to occur in the sea surface and sea floor of the southeast Alaska portion of the Study Area. The main diatom species in this portion of the Study Area are *Thalassiosira, Skeletonema,* and *Chaetoceros* (Waite et al. 1992).

3.7.2.2.4.2 Other Brown Algae Species

Most brown algae species are attached to the seafloor in coastal waters, although *Sargassum* may occur in a free-floating form in the Study Area (Eissinger 2009).Two species of brown algae dominate the Pacific Northwest, bull kelp (*Nereocystis leutkeana*) and giant kelp (*Macrocystis intergrifolia*). Bull kelp (*Nereocystis luetkeana*) can grow up to 5 inches (in.) (13 centimeters [cm]) per day (Dayton 1985). Bull kelp attaches to rocky substrate, and can grow up to 164 ft. (50 m) in length in nearshore areas. The giant kelp (*Macrocystis intergrifolia*) can live up to 8 years, and can reach lengths of 197 ft. (60 m). The leaf-like fronds can grow up to 24 in. (61 cm) per day (Leet et al. 2001). Sargassum (*Sargassum muticum*) is a non-indigenous brown algae from Asia and elsewhere that has been established in the Pacific Northwest for decades (Eissinger 2009).

Offshore Area

Kelp and Sargassum may occur in the sea surface of the Offshore Area of the Study Area. In turbid waters, the offshore edge of kelp beds occurs at depths of 50–60 ft. (15–18 m), which can extend to a depth of 100 ft. (30 m). The highest densities and most persistent kelp beds occur on solid rock substrate with moderately low relief and moderate sand coverage (Foster and Schiel 1985, Graham 1997). Sargassum, however, is least common along the outer coast, and offshore section of the Study Area (Shaffer 1998). Distribution of kelp and Sargassum in the Offshore Area is depicted in Figure 3.7-2.

Inland Waters

Kelp and *Sargassum* are known to occur in the sea surface and sea floor of the Inland Waters of the Study Area. Sargassum is common along the shorelines of the Hood Canal, San Juan Archipelago, and Strait of Georgia, whereas kelp is mostly found in the Strait of Juan de Fuca (Figure 3.7-2).

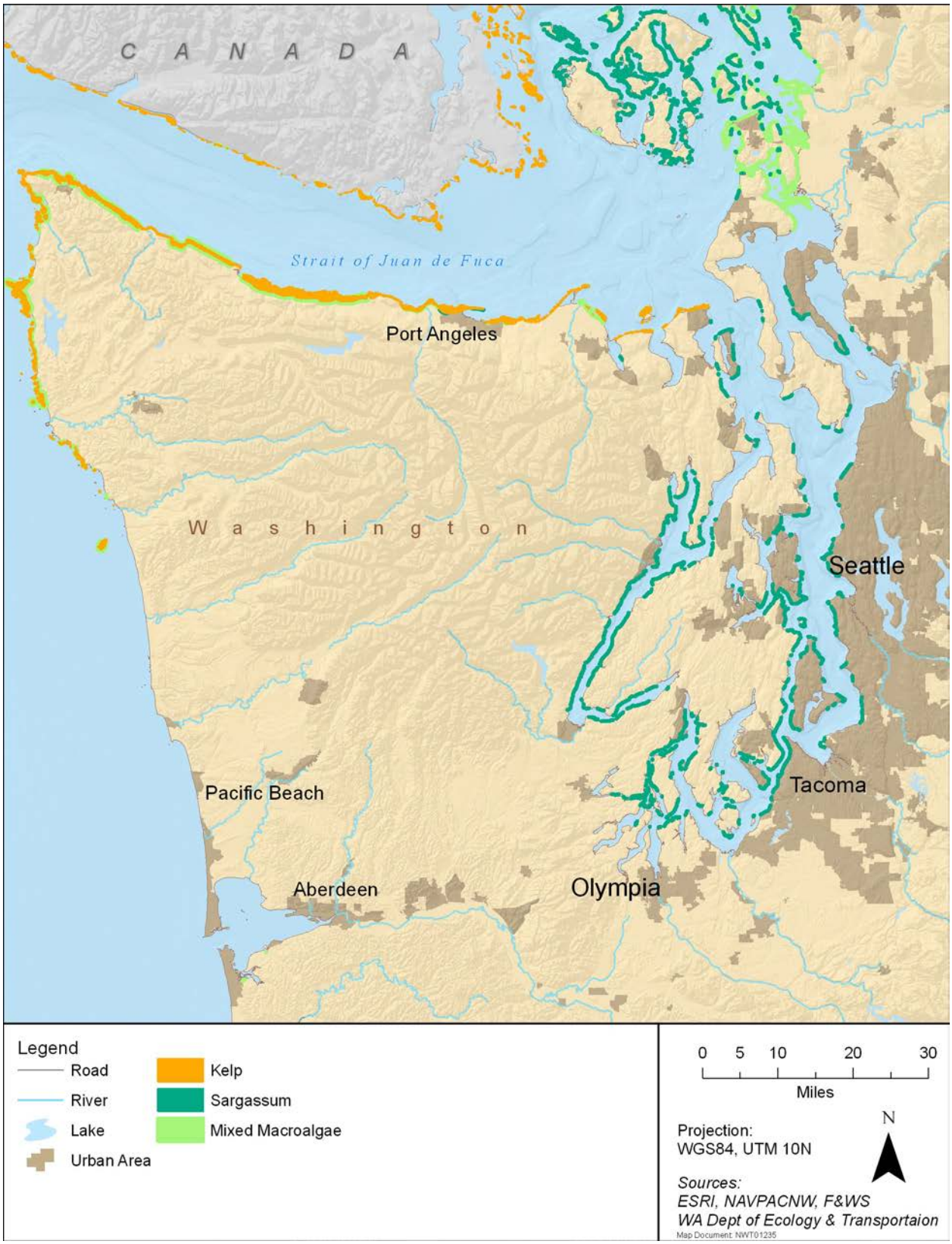

Figure 3.7-2: Kelp and *Sargassum* in the Northwest Training and Testing Study Area

Western Behm Canal, Alaska

Rockweed and kelp are known to occur in the sea surface and sea floor of the Western Behm Canal portion of the Study Area. Common species of rockweed and kelp in the Western Behm Canal portion of the Study Area include *Fucus distichus* and *Agarum marginata* (Guiry and Guiry 2013).

3.7.2.2.5 Red Algae (Phylum Rhodophyta)

Red algae are predominately marine, with approximately 4,000 species worldwide (Castro and Huber 2000). Red algal species exist in a range of forms, including single and multicellular forms (Bisby et al. 2010)—from fine filaments to thick calcium carbonate crusts.

3.7.2.2.5.1 Offshore Area

Red algae, such as *Rhodomela larix*, are known to occur in the sea surface of the Offshore Area of the Study Area (Guiry and Guiry 2013).

3.7.2.2.5.2 Inland Waters

Red algae are known to occur on the sea floor of the Inland Waters of the Study Area. Within this portion of the Study Area, a common species is *Mastocarpus papillatus* which is found in the waters of Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca (Lindstrom 2005).

3.7.2.2.5.3 Western Behm Canal, Alaska

In the Western Behm Canal portion of the Study Area shallow waters with rocky substrate are known to support red alga (*Rhodomela larix*) and even deeper waters were observed to be mainly sand substrates with patches of some red algae (U.S. Department of the Navy 1988).

3.7.2.2.6 Seagrasses and Cordgrasses (Phylum Spermatophyta)

Seagrasses and cordgrasses are flowering marine plants in the phylum Spermatophyta (Bisby et al. 2010). These marine flowering plants create important habitat for many marine species (Harborne et al. 2006, Heck et al. 2003, National Oceanic and Atmospheric Administration 2001). Cordgrasses are temperate salt-tolerant land plants that inhabit salt marshes, mudflats, and other soft-bottom coastal habitats (Castro and Huber 2000). Salt marshes develop in intertidal, protected low-energy environments, usually in coastal lagoons, tidal creeks, rivers, or estuaries (Mitsch et al. 2009).

Seagrasses are unique among flowering plants because they grow submerged in shallow marine environments. Except for some species that inhabit the rocky intertidal zone, seagrasses grow in shallow, subtidal, or intertidal sediments, and can extend over a large area to form seagrass beds (Garrison 2004; Phillips and Meñez 1988). Seagrass beds provide habitat for numerous vertebrates and invertebrates, including nurseries for commercially important crustaceans, fish, and shellfish (Harborne et al. 2006; Heck et al. 2003; National Oceanic and Atmospheric Administration 2001). Additionally, seagrass beds combat coastal erosion, promote nutrient cycling through the breakdown of detritus (Dawes 1998), and improve water quality. Seagrasses also contribute a high level of primary production to the marine environment, which supports high species diversity and biomass (Spalding et al. 2003).

3.7.2.2.6.1 Offshore Area

In the Pacific Northwest the dominant native seagrasses are eelgrass (*Zostera marina*) and surfgrass (*Phyllospadix* spp.) (den Hartog 1970). Eelgrass grows in shallow, subtidal or intertidal unconsolidated sediments, where as surfgrass grows on wave-beaten rocky shores. The primary vegetation in the Offshore Area is surfgrass (Figure 3.7-3).

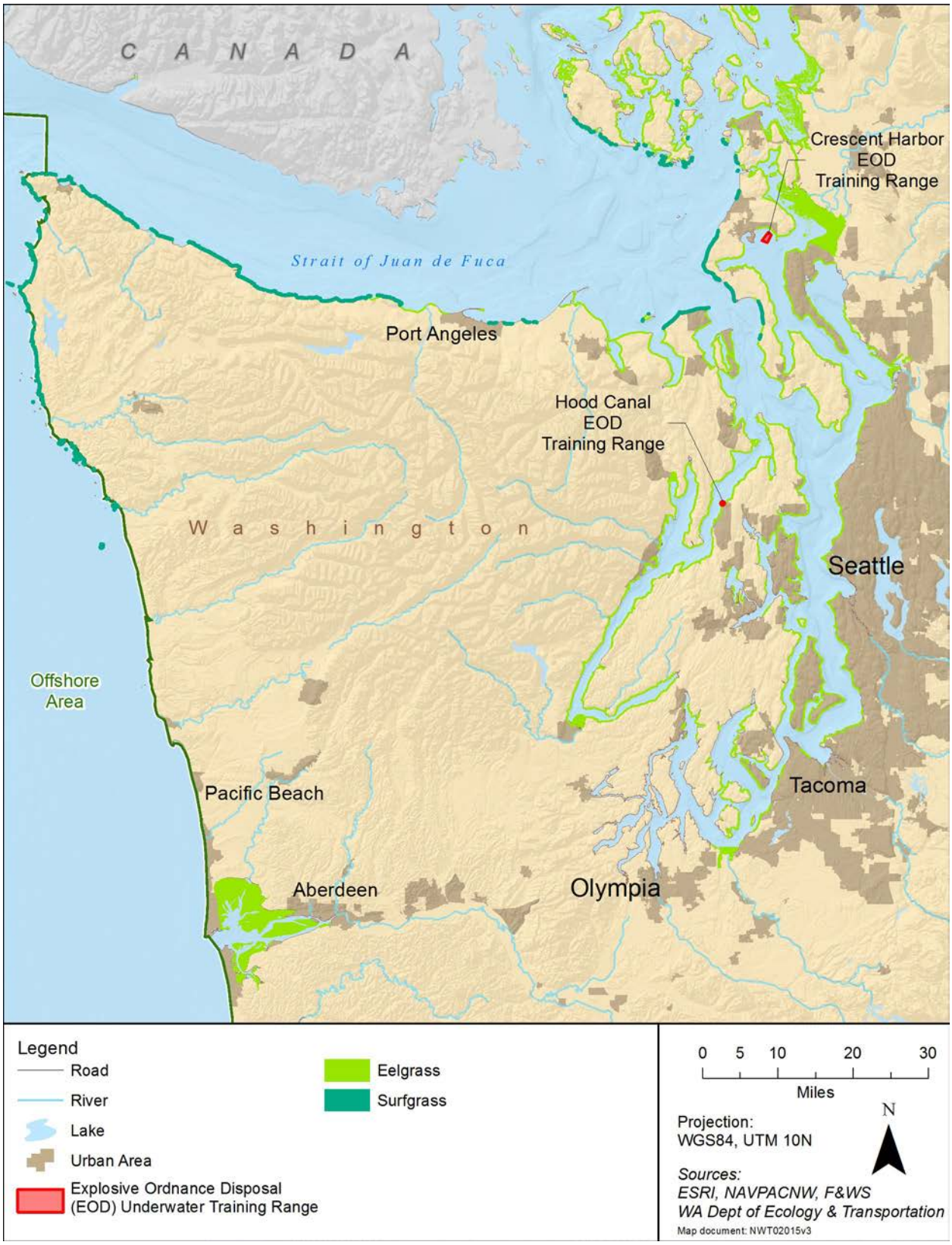

Figure 3.7-3: Surfgrass and Eelgrass in the Northwest Training and Testing Study Area

3.7.2.2.6.2 Inland Waters

Eelgrass grows in shallow, subtidal or intertidal unconsolidated sediments, whereas surfgrass grows on wave-beaten rocky shores. The primary vegetation in the intertidal areas of the Strait of Juan de Fuca and Puget Sound is eelgrass, which covers approximately 40 percent of the intertidal area (Bailey et al. 1998). Atlantic cordgrass (*Spartina alterniflora*) is a native cordgrass species from the Atlantic and Gulf coasts, and is considered an invasive species in the Study Area because it produces seeds at higher rates than the native cordgrass, and can quickly colonize mudflats (Howard 2008). Atlantic cordgrass is found in mudflats in Skagit, Clallam, and Jefferson counties (Puget Sound Partnership 2013).

3.7.2.2.6.3 Western Behm Canal, Alaska

Eelgrass is found in the Western Behm Canal portion of the study area on sandy substrates in deeper waters surrounding Back Island (U.S. Department of the Navy 1998).

3.7.3 ENVIRONMENTAL CONSEQUENCES

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) potentially impact marine vegetation. General characteristics of all Navy stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis), and living resources' general susceptibilities to stressors are described in Appendix H (Biological Resource Methods). Each marine vegetation stressor is introduced, analyzed by alternative, and analyzed for training activities and testing activities. Tables F-3 through F-5 in Appendix F show the warfare areas and associated stressors that were considered for analysis of marine vegetation.

The stressors vary in intensity, frequency, duration, and location within the Study Area (Table 3.7-2). Based on the general threats to marine vegetation discussed in Section 3.7.2 (Affected Environment) the stressors applicable to marine vegetation are:

- Acoustic (underwater explosives)
- Physical disturbance or strikes (vessel and in-water device disturbance, military expended materials)
- Secondary stressors (sediments and water quality)

Because marine vegetation is not susceptible to energy, entanglement, or ingestion stressors, those stressors will not be assessed. Only the Navy training and testing activity stressors and their components that occur in the same geographic location as marine vegetation are analyzed in this section. Training and testing activities pose no direct threat to some types of marine vegetation habitats. Training activities are not proposed in the Western Behm Canal; therefore, only the Offshore Area and the Inland Waters will be analyzed under Training Activities. Details of all training and testing activities, stressors, components that cause the stressor, and geographic occurrence within the Study Area, are summarized in Section 3.0.5.3 (Identification of Stressors for Analysis) and detailed in Appendix A (Navy Activities Descriptions).

3.7.3.1 Acoustic Stressors

This section analyzes the potential impacts of acoustic stressors that may occur during Navy training and testing activities on marine vegetation within the Study Area. The acoustic stressors that may impact marine vegetation include explosives that are detonated on or near the surface of the water, or underwater; therefore, only these types of explosions are discussed in this section.

3.7.3.1.1 Impacts from Underwater Explosives

Various types of explosives are used during training and testing activities. The type, number, and location of activities that use explosives under each alternative are discussed in Section 3.0.5.3.1.2 (Explosives). Explosive sources are the only acoustic stressor applicable to this resource because explosives could physically damage marine vegetation.

Table 3.7-2: Stressors for Marine Vegetation in the Northwest Training and Testing Study Area

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Acoustic Stressors							
Explosives	Offshore Area	378	0	502	148	502	164
	Inland Waters	4	0	42	0	42	0
	W. Behm Canal	0	0	0	0	0	0
Physical Disturbance and Strike Stressors							
Activities including vessels	Offshore Area	996	37	1,096	138	1,096	162
	Inland Waters	4	337	31	582	31	640
	W. Behm Canal	0	28	0	60	0	83
Activities including in-water devices	Offshore Area	429	40	484	154	484	183
	Inland Waters	0	379	1	648	1	716
	W. Behm Canal	0	0	0	0	0	0
Military expended materials	Offshore Area	189,668	621	196,888	2,511	196,888	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Activities including seafloor devices	Offshore Area	0	5	0	6	0	7
	Inland Waters	2	210	16	225	16	239
	W. Behm Canal	0	0	0	5	0	15
Secondary Stressors							
Habitat (sediments and water quality; air quality)	Offshore Area	QUALITATIVE					
	Inland Waters						
	W. Behm Canal						

The potential for an explosion to injure or destroy marine vegetation would depend on the amount of vegetation present, the number of munitions used, and their net explosive weight. In areas where marine vegetation and locations for explosions overlap, vegetation on the surface of the water, in the water column, or rooted in the seafloor may be impacted. Single-celled algae may overlap with acoustic stressors, but the impact would be minimal relative to their total population level; therefore, they will not be discussed further. Seafloor macroalgae, seagrass, and eelgrass may overlap with underwater and sea surface explosion locations. If these vegetation types are near an explosion, only a small number of them are likely to be impacted relative to their total population level. The low number of explosions relative to the amount of seafloor macroalgae in the Study Area also decreases the potential for impacts on these vegetation types. In addition, seafloor macroalgae are resilient to high levels of wave action (Mach et al. 2007), which may aid in their ability to withstand underwater explosions that occur near

them. Underwater explosions also may temporarily increase the turbidity (sediment suspended in the water) of nearby waters, incrementally reducing the amount of light available to marine vegetation. This increase in the amount of sediments and nutrients (e.g., iron) in the water may cause algal blooms (Anderson et al. 2002). Additionally, areas of sea floor impacted by explosions may become re-colonized by algae species (Emerson and Zedler 1978).

3.7.3.1.1.1 No Action Alternative

Training Activities

Offshore Area

Under the No Action Alternative, training activities would utilize source class E4 explosives, which detonate at a depth of 66 ft. (20 m); source class E5 explosives, which detonate at a depth of 1 ft. (0.3 m); source class E8 and source class E11 explosives, both of which detonate at a depth of 90 ft. (27 m); and source class E12 explosives, which detonate at a depth of 3.3 ft. (1 m) (see Table 3.0-11). There are 378 training activities proposing the use of underwater explosions in the Offshore Area under the No Action Alternative. These explosions would likely occur over unvegetated seafloor because it is the predominant bottom type in the areas proposed for these activities; in addition, detonations would occur in waters greater than 200 ft. (61 m) in depth and greater than 3 nautical miles (nm) from shore. Detonations associated with anti-submarine warfare (source class E4) would typically occur in water greater than 600 ft. (183 m) depth. Underwater and surface explosions conducted for training activities in the Offshore Area are not expected to result in detectable changes to kelp beds, floating marine algae, or other marine algae because (1) the relative coverage of marine algae and vegetation is low in this portion of the Study Area, (2) new growth may result from floating and attached marine algae and vegetation exposure to explosives (see Section 3.7.3.1.1, Impacts from Underwater Explosives; Emerson and Zedler 1978), and (3) the impact area of underwater explosions is very small (see Figure 2.1-2) relative to marine algae and vegetation distribution. Based on these factors, potential impacts on marine algae and vegetation from underwater and surface explosions are not expected to result in detectable changes to growth, survival, or propagation, and are not expected to result in population level impacts.

Inland Waters

The potential for seagrass, cordgrass, and eelgrass to overlap with underwater and surface explosions is limited to Underwater Demolition Training areas in Crescent Harbor and Hood Canal. Seagrasses could be uprooted or damaged by sea surface or underwater explosions. They are much less resilient to disturbance than other marine algae; regrowth after uprooting can take up to 10 years (Dawes et al. 1997). Explosions may also temporarily increase the turbidity (sediment suspended in the water) of nearby waters, but the sediment would settle to pre-explosion conditions within a number of days. Sustained high levels of turbidity may reduce the amount of light that reaches vegetation.

Under the No Action Alternative, there would be a total of four explosive training events in the inshore portion of the Study Area. The impact of underwater explosions from mine neutralization activities on bottom habitats provides some perspective on the potential impact area. The total impact footprint of all underwater explosions under the No Action Alternative on bottom habitats would be approximately 313.28 square feet ($ft.^2$) (29.1 m^2). This impact footprint is small relative to the distribution of marine algae, such as kelp, in the inland portion of the Study Area, which is over 45.7 square nautical miles (nm^2).

Underwater and surface explosions conducted for training activities in the Inland Waters are not expected to pose a risk to seagrass because (1) the impact area of underwater explosions is very small

(313.28 ft.^{2} [29.1 m^2]) relative to seagrass distribution (45.7 nm^2); (2) the low number of charges reduces the potential for impacts; and (3) disturbance would be temporary, dependent upon the level of sediment redistributed, the amount of time it takes the sediment to settle, and the amount of light that reaches the disturbed area. The use of surface and underwater explosions is not expected to result in detectable changes to their growth, survival, or propagation, and is not expected to result in population-level impact for marine algae and seagrass.

Testing Activities

Offshore Area

No testing activities with underwater, surface, or seafloor detonations are proposed in the Offshore Area under the No Action Alternative.

Inland Waters

No testing activities with underwater, surface, or seafloor detonations are proposed in the Inland Waters under the No Action Alternative.

Western Behm Canal, Alaska

No testing activities with underwater, surface, or seafloor detonations are proposed in the Western Behm Canal under the No Action Alternative.

3.7.3.1.1.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, the total number of explosives used in training events in the Offshore Area would increase by approximately 33 percent over No Action Alternative (see Table 3.7-2). The potential impacts on marine algae and vegetation from exposure to underwater and surface explosions are slightly increased, but remain similar in nature as described in Section 3.7.3.1.1.1 (No Action Alternative).

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk to marine algae from exposure to underwater and surface explosions. However, most of the increase under Alternative 1 comes from explosives with less than 10 pounds (lb.) of net explosive weight (see Table 3.0-11). Underwater and surface explosions conducted for training activities are not expected to pose a risk to marine algae and vegetation because (1) the impact area of underwater explosions is very small relative to marine algae and vegetation distribution in this portion of the Study Area; (2) the low number of charges reduces the potential for impacts; and (3) disturbance would be temporary, dependent upon the level of sediment redistributed, the amount of time it takes the sediment to settle, and the amount of light that reaches the disturbed area. For the same reasons as stated in Section 3.7.3.1.1.1 (No Action Alternative) for marine algae and vegetation, the use of surface and underwater explosions is not expected to result in detectable changes to their growth, survival, or propagation, and are not expected to result in population-level impacts.

Inland Waters

Under Alternative 1, the total number of explosive training events would increase relative to the No Action Alternative, due to the additional use of 18 shock wave action generators (SWAG) in Crescent Harbor and 18 SWAG in Hood Canal. The mine neutralization exercises would increase from two 1.5 lb. mine neutralization charges to three 2.5 lb. charges in Hood Canal and from two to three 2.5 lb. mine neutralization exercises in Crescent Harbor.

The potential impacts on marine algae from exposure to underwater and surface explosions are as described in Section 3.7.3.1.1.1 (No Action Alternative). The impact of underwater explosions from mine neutralization activities on bottom habitats provides some perspective on the potential impact area. The impact footprint of underwater explosions on bottom habitats in the Inland Waters of the Study Area for the three 2.5 lb. charges and 18 SWAG (that occur three times) in Crescent Harbor, along with the three 2.5 lb. charges and 18 SWAG (that occur three times) in the Hood Canal Range, is approximately 823.14 $ft.^2$ (76.5 m^2) (see Table 2.8-1, Baseline and Proposed Training Activities). This impact footprint is small (see Figure 2.1-3) relative to the distribution of marine algae, such as kelp, in the Study Area.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk to marine algae from exposure to underwater and surface explosions. However, underwater and surface explosions conducted for training activities are not expected to cause population level impacts to seagrass because (1) the impact area of underwater explosions is very small (see Figure 2.1-2) relative to seagrass distribution; (2) the low number of charges reduces the potential for impacts; and (3) disturbance would be temporary, dependent upon the level of sediment redistributed, the amount of time it takes the sediment to settle, and the amount of light that reaches the disturbed area. For the same reasons as stated in Section 3.7.3.1.1.1 (No Action Alternative) for marine algae and seagrass, the use of surface and underwater explosions is not expected to result in detectable changes to their growth, survival, or propagation, and is not expected to result in population-level impacts.

Testing Activities

Offshore Area

Under Alternative 1, testing activities would involve the use of 148 explosives, during activities such as Naval Sea Systems Command (NAVSEA) torpedo testing and Naval Air Systems Command (NAVAIR) Improved Extended Echo Ranging (IEER) testing (see Tables 2.8-2 and 2.8-3). The majority of underwater explosions in the Offshore Area would occur over unvegetated seafloor because it is the predominant bottom type in the areas proposed for these activities. Underwater and surface explosions conducted for testing activities in the Offshore Area are not expected to cause any risk to marine algae and vegetation because (1) the relative coverage of marine algae and vegetation is low (see Figure 2.1-2), (2) new growth may result from marine algae and vegetation exposure to explosives (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of underwater explosions is very small (see Figure 2.1-2) relative to marine algae and vegetation distribution in this portion of the Study Area. Based on these factors, potential impacts on marine algae and vegetation from underwater and surface explosions are not expected to result in detectable changes to growth, survival, or propagation, and are not expected to result in population level impacts.

Inland Waters

No testing activities with underwater, surface, or seafloor detonations are proposed in the Inland Waters under Alternative 1.

Western Behm Canal, Alaska

No testing activities with underwater, surface, or seafloor detonations are proposed in the Western Behm Canal under Alternative 1.

3.7.3.1.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the same number of underwater detonations would occur as under Alternative 1. Therefore, underwater detonations in the Offshore Area under Alternative 2 would have the same impacts on marine algae and vegetation as under Alternative 1.

Inland Waters

Under Alternative 2, the same number of underwater detonations would occur in the Inland Waters as under Alternative 1. Therefore, underwater detonations under Alternative 2 would have the same impacts on marine vegetation as under Alternative 1.

Testing Activities

Offshore Area

Under Alternative 2, testing activities would involve the use of explosives, such as NAVSEA torpedo testing and NAVAIR IEER testing (see Tables 2.8-2 and 2.8-3) and would increase by approximately 10 percent over Alternative 1. The majority of underwater explosions in the Offshore Area would likely occur over unvegetated seafloor because it is the predominant bottom type in the areas proposed for these activities. Underwater and surface explosions conducted for testing activities in the Offshore Area are not expected to cause any risk to marine algae and vegetation because (1) the relative coverage of marine algae and vegetation is low (see Figure 2.1-2), (2) new growth may result from marine algae and vegetation exposure to explosives (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of underwater explosions is very small (see Figure 2.1-2) relative to marine algae and vegetation distribution. Based on these factors, potential impacts on marine algae and vegetation from underwater and surface explosions are not expected to result in detectable changes to growth, survival, or propagation, and are not expected to result in population level impacts.

Inland Waters

No testing activities with underwater, surface, or seafloor detonations are proposed in the Inland Waters under Alternative 2.

Western Behm Canal, Alaska

No testing activities with underwater, surface, or seafloor detonations are proposed in the Western Behm Canal, Alaska portion of the Study Area under Alternative 2.

3.7.3.1.2 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Explosives (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives during training and testing activities may have an adverse effect on EFH by reducing the quality and quantity of marine vegetation that constitutes EFH or Habitat Areas of Particular Concern. Impact on attached macroalgae is determined to be minimal and temporary to short term throughout the Study Area. Given the available information, the impact on submerged rooted vegetation beds is determined to be minimal and long term.

3.7.3.2 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts on marine vegetation of the various types of physical disturbance stressors during training and testing activities within the Study Area. Three types of physical

stressors are evaluated for their impacts on marine vegetation, including (1) vessels and in-water devices, (2) military expended materials, and (3) seafloor devices.

The evaluation of the impacts of physical disturbance stressors on marine vegetation focuses on proposed activities that may cause vegetation to be damaged by an object that is moving through the water (e.g., vessels and in-water devices), or dropped to the seafloor (e.g., military expended materials, anchors). Not all activities are proposed throughout the Study Area. Wherever appropriate, specific geographic areas of potential impact are identified.

Single-celled algae may overlap with physical disturbance stressors. However, as suspended particles, they are displaced by vessel movement in the same way as the water around them. The impact is negligible because the nature of the activity does not alter lifecycle or habitat; therefore, it does not affect the productivity or population health of these species. Impacts to single-cell algae will not be discussed further. Seagrasses and macroalgae on the seafloor on the sea surface are the only types of marine vegetation that occur in locations where physical disturbance stressors may be encountered. Therefore, only seagrasses and macroalgae are analyzed further for potential impacts of physical disturbance or strike stressors. Since the occurrence of marine algae is an indicator of marine mammal and sea turtle presence, some mitigation measures designed to reduce impacts on these resources may indirectly reduce impacts on marine algae; see Section 5.3.2.2 (Physical Disturbance and Strike).

3.7.3.2.1 Impacts from Vessels and In-Water Devices

Several different types of vessels (ships, submarines, boats, amphibious vehicles) and in-water devices (towed devices and unmanned underwater vehicles [UUVs]) are used during training and testing activities throughout the Study Area, as described in Section 3.0.5.3.3.1 (Vessels). Vessel movements occur intermittently, are variable in duration, ranging from a few hours to a few weeks, and are dispersed throughout the Study Area. Events involving large vessels are widely spread over offshore areas, while smaller vessels are more active in nearshore areas.

The potential impacts of Navy vessels and in-water devices used during training and testing activities on marine vegetation are based on the vertical distribution of the vegetation. Surface vessels include ships, boats, and amphibious vehicles, and seafloor devices include UUVs and autonomous underwater vehicles. Vessels may impact vegetation by disturbing vegetation on the sea surface or seafloor (Spalding et al. 2003). In the open ocean, marine algae on the sea surface such as kelp paddies have a patchy distribution. Marine algae could be temporarily disturbed by moving vessels or by the propeller action of transiting vessels. Fragmentation would be on a small spatial scale, and marine algal mats would be expected to re-form. These disturbances could also injure the organisms that inhabit kelp paddies or other marine algal mat, such as sea turtles, birds, marine invertebrates, and fish (see Sections 3.5, 3.6, 3.8, and 3.9, respectively). In open-ocean areas, marine algae on the sea surface may be disturbed by vessels and in-water devices. Marine algae could be temporarily disturbed by transiting vessels or by their propellers. It is resilient to winds, waves, and severe weather that could sink the mat or break it into pieces. Impacts on marine algae by vessels and in-water devices may collapse the pneumatocysts (air sacs) that keep the mats afloat. Evidence suggests that some floating marine algae will continue to float even when up to 80 percent of the pneumatocysts are removed (Zaitsev 1971).

Seafloor macroalgae may be present in locations where these vessels and in-water devices occur, but the impacts would be minimal because of their resilience, distribution, and biomass, although some types of microalgae are expected to recover faster than others. A literature search of at-risk marine macroalgae species in the Study Area (International Union for Conservation of Nature 2012) did not

indicate that these species are more resilient to stressors than other marine vegetation. Additionally, seafloor macroalgae in coastal areas are adapted to natural disturbances, such as storms and wave action that can exceed 33 ft. (10 m) per second (Mach et al. 2007), and are expected to quickly recover from vessel and in-water device movements.

Towed in-water devices include towed targets that are used during activities such as Missile Exercises and Gun Exercises. These devices are operated at low speeds either on the sea surface or below it. The analysis of in-water devices will focus on towed surface targets because of the potential for impacts on marine algae. Unmanned underwater vehicles and autonomous underwater vehicles are used in training and testing activities in the Study Area. They are typically propeller-driven, and operate within the water column. The propellers of these devices are encased, eliminating the potential for seagrass propeller scarring. Algae on the seafloor could be disturbed by these devices; however, for the same reasons given for vessel disturbance, UUVs are not expected to compromise the health or condition of algae, and the impact would be minimal relative to their total population level.

Estimates of relative vessel use and location for each alternative are provided in Section 3.0.5.3.3.1 (Vessels). These estimates are based on the number of activities predicted for each alternative. While these estimates provide a prediction of use, actual Navy vessel use depends upon military training and testing requirements, deployment schedules, annual budgets, and other unpredictable factors. Testing and training activity concentrations are most dependent upon locations of Navy shore installations and established testing and training areas.

Under all alternatives, a variety of vessels and in-water devices would be used throughout the Study Area during training and testing activities, as described in Chapter 2 (Description of Proposed Action and Alternatives). The concentration of use in and the manner in which the Navy uses vessels to accomplish its mission requirements is likely to remain consistent with the range of variability observed over the last decade. Consequently, the Navy is not proposing appreciable changes in the levels, frequency, or locations where vessels have been used over the last decade.

On the open ocean, vessel disturbance of marine vegetation would be limited to floating marine algae. Vessel movements may disperse or injure algal mats. Because algal distribution is patchy, mats may re-form, and events would be on a small spatial scale. Navy training activities involving vessel movement would not impact the general health of marine algae; the impact would be minimal relative to their total population level. Navy protective measures would ensure that vessels avoid large algal mats, eelgrass beds, or other sensitive vegetation that other marine life depend on for food or habitat; these measures would safeguard sensitive vegetation from vessel strikes. In addition, Navy protective measures would require helicopter crews that tow in-water devices for mine warfare exercises to monitor the water surface before and during exercises to identify and avoid marine algae, algal mats, eelgrass beds, or other sensitive vegetation that other marine life depend on for food or habitat.

Marine vegetation in the path of moving vessels or in-water devices may have a clearly detectable response (e.g., algal mats dispersing, rupture of individual plant cells), followed by a recovery period lasting weeks to months. Marine vegetation growth near vessels or in-water devices used for training activities under the No Action Alternative, Alternative 1, and Alternative 2 would be inhibited during recovery. However, long-term survival, reproductive success, or lifetime reproductive success on a population level would not be impacted.

3.7.3.2.1.1 No Action Alternative

Training Activities

Offshore Area

Under the No Action Alternative, the impacts of vessel and in-water devices physical disturbances of marine vegetation during training activities in the Offshore Area would be limited to floating algal mats and seaweeds. The net impact of vessel, in-water device, and in-water device physical disturbances on marine vegetation is expected to be short-term and temporary based on (1) the implementation of Navy protective measures; (2) the quick recovery (weeks) of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Inland Waters

Under the No Action Alternative, the impacts of vessel physical disturbances on marine vegetation during training activities in the Inland Waters would be limited to floating algal mats, kelp canopies, and seaweeds. No training activities involving in-water devices occur in the inland waters. Vessel movement for training activities in the Inland Waters is caused by the small boats for Explosive Ordnance Disposal (EOD), and the Sea, Air, Land Teams, and by access between pier and open water activities. The net impact of vessel physical disturbances on marine vegetation is expected to be negligible under the No Action Alternative, based on (1) the implementation of Navy protective measures; (2) the quick recovery of most vegetation types; and (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas.

Testing Activities

Offshore Area

Under the No Action Alternative, testing activities in the Offshore Area would include activities where vessels and in-water devices could come in contact with marine vegetation, including certain types of UUVs used in the Quinault Range Site during such training events as Recovery Operations (Appendix A.2.4.1). However, most testing activities in the Offshore Area would occur at depths greater than 100 ft. (30 m). Surf zone activities would occur in the Offshore Area at Pacific Beach in the Quinault Range Site, which extends north to south 5 nm along the eastern boundary of W-237A, approximately 3 nm to shore along the mean low water line, and encompasses 1 mile (1.6 km) of shoreline at Pacific Beach, Washington. Surf zone activities would be conducted from an area on the shore going toward the sea. Surf zone activities have the potential to effect marine vegetation that is rooted to the sea floor or floating in the water column. However, these testing activities are unlikely to have a population level effect on marine vegetation under the No Action Alternative. The net impact of vessel, in-water device physical disturbances on marine vegetation is expected to be negligible based on (1) the implementation of Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Inland Waters

Under the No Action Alternative, testing activities in the Inland Waters of the Study Area would include activities where vessels and in-water devices, such as with certain types of UUVs, could come in contact marine vegetation. These in-water devices used for testing activities could have a temporary (not permanent) effect on marine vegetation under the No Action Alternative. The net impact of vessel and

in-water devices physical disturbances on marine vegetation is expected to be short term and temporary under the No Action Alternative, based on (1) the implementation of Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Western Behm Canal, Alaska

Under the No Action Alternative, approximately 28 events under testing activities involving vessels would occur in the Western Behm Canal portion of the Study Area (see Table 3.7-2). These vessels used for testing activities could have an effect on marine vegetation under the No Action Alternative. The net impact of vessel physical disturbances on marine vegetation is expected to be short term and temporary under the No Action Alternative, based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; and (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas. Therefore, eelgrass and seagrass bed damage is not likely; however, if it occurs, the impacts would be minor, such as short-term turbidity increases.

3.7.3.2.1.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, training activities that involve vessels and in-water devices in the Offshore Area would increase slightly, from 1,425 events in the No Action Alternative to 1,572 events (see Table 3.7-2). The impacts of vessel physical disturbances of marine vegetation during training activities in the Offshore Area would be limited to floating algal mats and seaweeds. The net impact of vessel and in-water device physical disturbances on marine vegetation is expected to be short term and temporary based on (1) the implementation of Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Inland Waters

Under Alternative 1, training activities that involve vessels and in-water devices in the Inland Waters of the Study Area would increase by 28 events over the No Action Alternative (see Table 3.7-2). The Navy follows protective measures that minimize conduct of training within zones of algal mats or fixed vegetation, so the risk of causing direct injury is low. Under Alternative 1, the impacts of vessel physical disturbances, including the addition of new Anti-Surface Warfare activities at Crescent Harbor; small boat Anti-Terrorism Force Protection at Crescent Harbor, Hood Canal, and the Keyport Range site; and the addition of in-water devices (used in Civilian Port Defense) during training activities in the inshore waters, would cause minimal disturbances to algal mats, kelp canopies, and seaweeds. The net impact of vessel physical disturbances on marine vegetation is expected to be negligible under Alternative 1, based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation. Therefore, eelgrass and seagrass bed damage is not likely; however, if it occurs, the impacts would be minor, such as short-term (weeks) turbidity increases.

Testing Activities

Offshore Area

Under Alternative 1, testing activities that would include vessels and in-water devices would increase by approximately 215 events over the No Action Alternative (see Table 3.7-2). This increase would be in the tempo of testing activities in the Offshore Area, not the type of activities as described under the No Action Alternative. Therefore, the impacts under Alternative 1 would be expected to be similar to those described under the No Action Alternative. Under Alternative 1, the net impact of vessel and in-water device physical disturbances on marine vegetation is expected to be negligible based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Inland Waters

Under Alternative 1, testing activities that involve vessels and in-water devices in the Inland Waters of the Study Area would increase to 1,230 events over 716 events under the No Action Alternative (see Table 3.7-2). Additionally, testing activities that involve vessels and in-water devices would be extended to Carr Inlet. Testing activities in the Inland Waters of the Study Area would include activities where vessels and in-water devices could come in contact marine vegetation, such as with certain types of UUVs. These in-water devices used for testing activities could have an effect on marine vegetation under Alternative 1. The net impact of vessel physical disturbances on marine vegetation is expected to be negligible under Alternative 1, based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation. Therefore, eelgrass and seagrass bed damage is not likely but, if it occurs, the impacts would be minor, such as short-term turbidity increases.

Western Behm Canal, Alaska

Under Alternative 1, approximately 60 events under testing activities involving vessels would occur in the Western Behm Canal portion of the Study Area (see Table 3.7-2). These vessels used for testing activities could have an effect on marine vegetation under Alternative 1. The net impact of vessel physical disturbances on marine vegetation is expected to be negligible under Alternative 1, based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; and (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas. Therefore, eelgrass and seagrass bed damage is not likely but, if it occurs, the impacts would be minor, such as short-term turbidity increases.

3.7.3.2.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, training activities that involve vessels in the Offshore Area would remain the same as under Alternative 1 (see Table 3.7-2). The impacts of vessel physical disturbances of marine vegetation during training activities in the Offshore Area would be limited to floating algal mats and seaweeds. The net impact of vessel and in-water device physical disturbances on marine vegetation is expected to be negligible based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the

deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Inland Waters

Under Alternative 2, training activities that involve vessels and in-water devices in the Inland Waters of the Study Area would remain the same number as described under Alternative 1 (see Table 3.7-2). Therefore, impacts from training in the Inland Waters would be similar to what is described in Section 3.7.3.2.1.2 (Alternative 1).

Testing Activities

Offshore Area

Under Alternative 2, testing activities that would include vessels and in-water devices would increase by approximately 268 events over the No Action Alternative (see Table 3.7-2). This increase would be in the tempo of testing activities by NAVAIR and NAVSEA in the Offshore Area, but it would not increase the potential effect on marine vegetation. Therefore the net impact of vessel and in-water device physical disturbances on marine vegetation is expected to be negligible based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas; and (4) the deployment of in-water devices at depths where they would not likely come in contact with marine vegetation.

Inland Waters

Under Alternative 2, the number of testing activities involving vessels, and in-water devices in the Inland Waters would increase by 10 percent compared to Alternative 1 (see Table 3.7-2). Despite this increase, the impacts to marine vegetation are expected to be the same as under Alternative 1.

Western Behm Canal, Alaska

Under Alternative 2, approximately 83 events under testing activities involving vessels would occur in the Western Behm Canal portion of the Study Area (see Table 3.7-2). These vessels used for testing activities could have an effect on marine vegetation under Alternative 2. The net impact of vessel physical disturbances on marine vegetation is expected to be negligible under Alternative 2, based on (1) Navy protective measures; (2) the quick recovery of most vegetation types; and (3) the short-term nature of most vessel movements and local disturbances of the surface water, with some temporary increase in suspended sediment in shallow areas. Therefore, eelgrass and seagrass bed damage is not likely but, if it occurs, the impacts would be minor, such as short-term turbidity increases.

3.7.3.2.1.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Vessels and In-Water Devices (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of vessels and in-water devices during training and testing activities would have no impact on attached macroalgae or submerged rooted vegetation that constitutes EFH or Habitat Areas of Particular Concern. Any impacts on marine vegetation incurred by vessel movements and in-water devices would be minimal and short term.

3.7.3.2.2 Military Expended Materials

This section analyzes the disturbance potential to marine vegetation of the following categories of military expended materials: (1) non-explosive practice munitions; (2) fragments of high-explosive munitions; and (3) expended materials other than ordnance, such as sonobuoys, vessel hulks, and

expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each Alternative, see Section 3.0.5.3.3.3 (Military Expended Material).

Military expended materials can impact floating marine algae in the open ocean, and seagrass and other types of algae on the seafloor in coastal areas. Single-celled algae would not be impacted by military expended materials due to the nature of the algae and because there would not be any population-level impacts. Most types of military expended materials are deployed in the open ocean. In coastal water training areas, only projectiles (small and medium), target fragments, and countermeasures could be introduced into areas where shallow water vegetation such as seagrass and seafloor macroalgae may be impacted.

The following are descriptions of the types of military expended materials that could impact marine algae and seagrass. Marine algae could overlap with military expended materials anywhere in the Study Area. Puget Sound is the only location where these materials could overlap with seagrasses. Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 present the numbers and locations of activities that expend military materials during training and testing activities by location and alternative.

Small-, Medium-, and Large-Caliber Projectiles. Small-, medium-, and large-caliber non-explosive practice munitions, or fragments of high-explosive projectiles expended during training and testing activities rapidly sink to the seafloor. The majority of these projectiles would be expended in the open ocean areas of the Study Area. Because of the small sizes of the projectiles and of their casings, damage to marine vegetation is unlikely. Large-caliber projectiles are primarily used in the Offshore Area at depths greater than 26 m (85.3 ft.), while small- and medium-caliber projectiles would be expended in both offshore and coastal areas at depths less than 26 m (85.3 ft.). Marine algae could occur where these materials are expended, but seagrasses generally do not because these activities do not normally occur in water that is shallow enough for seagrass to grow (26 m [85.3 ft.]).

Bombs, Missiles, and Rockets. Bombs, missiles, and rockets, or their fragments (if high-explosive) are expended offshore (at depths greater than 26 m [85.3 ft.]) during training and testing activities, and rapidly sink to the seafloor. Marine algae could occur where these materials are expended, but seagrass generally does not because of water depth limitations for activities that expend these materials.

Parachutes. Parachutes of varying sizes are used during training and testing activities. The types of activities that use parachutes, the physical characteristics of these expended materials, where they are used, and the number of activities that would occur under each alternative are discussed in Section 3.0.5.3.4.2 (Parachutes). Marine algae could occur in any of the locations where these materials are expended.

Targets. Many training and testing activities use targets. Targets that are hit by munitions could break into fragments. Target fragments vary in size and type, but most fragments are expected to sink. Pieces of targets that are designed to float are recovered when possible. Marine algae and seagrass could occur where these materials are expended.

Vessel Hulk. Vessel hulks are a notable type of military expended material because of their size. Vessel hulks are expended at sea during sinking exercises (SINKEX). Sinking exercises use a target (vessel hulk) against which live high-explosive or non-explosive munitions are fired; the SINKEX is conducted in a manner that results in the sinking of the target. This activity would only be conducted in designated

areas with bottom depths greater than 3,000 m (9,842.5 ft.). Floating marine algal mats could occur where these materials are expended, but seagrass could not.

Countermeasures. Defensive countermeasures such as chaff and flares are used to protect against missile and torpedo attack. Chaff is made of aluminum-coated glass fibers and flares are pyrotechnic devices. Chaff, chaff canisters, and flare end caps are expendable materials. Chaff and flares are dispensed from aircraft or fired from ships. Floating marine algal mats could occur in any of the locations that these materials are expended.

3.7.3.2.2.1 No Action Alternative

Training Activities

Offshore Area

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials, most of which are small- and medium-caliber projectiles. The numbers and footprints of military expended materials from training activities under the No Action Alternative in the Offshore Area are detailed in Tables 3.7-2 and 3.3-4.

Floating marine algal mats and other types of algae that occur on the sea surface in the Offshore Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae (Schoener and Rowe 1970) and would, therefore, not be expected to impact the population. This disturbance would have a minor, temporary impact on marine algae. These stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish); for analysis of potential impacts on the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

The largest deposition in the No Action Alternative training activities is the SINKEX hulk that goes into very deep water. The rest of the material deposited is typically in small fragments. Military expended materials used for training activities are not expected to pose a risk to marine algae because (1) the relative coverage of marine algae in the Offshore Area is low, (2) new growth may result from marine algae exposure to military expended materials (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of military expended materials is very small relative to marine algae distribution. Based on these factors, potential impacts on marine algae from military expended materials in the Offshore Area are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts. There are no potential impacts on seagrass.

Inland Waters

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials in the Study Area. The numbers and footprints of military expended materials in the Inland Waters are detailed in Tables 3.7-2 and 3.3-6.

Kelp, cordgrass, seagrass and other types of algae that occur on the in the Inland Waters of the Study Area may be temporarily disturbed when sediments are displaced by object settlement. Sediment displacement may cause short-term, local turbidity. This type of disturbance would not likely be different from conditions created by waves or rough weather (Mach et al. 2007). This disturbance would have no impact to marine algae. Although these stressors may impact the organisms that inhabit marine

algae (e.g., sea turtles, birds, marine invertebrates, and fish), for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

Military expended materials used for training activities in the Inland Waters are not expected to pose a risk to marine algae, cordgrass, and seagrass because (1) new growth may result from exposure to military expended materials, and (2) the impact area of military expended materials is very small relative to marine algae and seagrass distribution. Based on these factors, potential impacts on marine algae and seagrass from military expended materials in the Inland Waters portion of the Study Area are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts.

Testing Activities

Offshore Area

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials. The numbers and footprints of military expended materials from testing activities under the No Action Alternative in the Offshore Area are detailed in Tables 3.7-2 and 3.3-5.

Floating marine algal mats and other types of algae that occur on the sea surface in the Offshore Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae (Schoener and Rowe 1970) and would, therefore, not be expected to impact the population. This disturbance would have no impact to marine algae. These stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish); for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

Under the No Action Alternative, military expended materials used for testing activities in the Offshore Area are not expected to pose a risk to marine algae because (1) the relative coverage of marine algae in the Study Area is low, (2) new growth may result from marine algae exposure to military expended materials (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of military expended materials is very small relative to marine algae distribution. Based on these factors, potential impacts on marine algae in the Offshore Area from military expended materials are not expected to result in detectable changes in its growth, survival, or propagation, and are not expected to result in population-level impacts. There are no potential impacts on seagrass.

Inland Waters

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials. The numbers and footprints of military expended materials in the Inland Waters of the Study Area are detailed in Tables 3.7-2 and 3.3-6.

Under the No Action Alternative, military expended materials used for testing activities in the Inland Waters of the Study Area are not expected to pose a risk to marine algae, cordgrass, and seagrass because (1) new growth may result from marine algae exposure to military expended materials, and (2) the impact area of military expended materials is very small relative to marine algae distribution. Based on these factors, potential impacts on marine algae and seagrass in the Inland Waters of the Study Area from military expended materials are not expected to result in detectable changes in its growth, survival, or propagation, and are not expected to result in population-level impacts.

Western Behm Canal, Alaska

No testing activities with military expended materials are proposed in the southeast Alaska portion of the Study Area under the No Action Alternative.

3.7.3.2.2.2 Alternative 1

Training Activities

Offshore Area

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials, most of which are small- and medium-caliber projectiles. The numbers and footprints of military expended materials are detailed in Tables 3.7-2 and 3.3-4. Under Alternative 1, military expended materials would increase in the Offshore Area by approximately 4 percent as compared to the No Action Alternative.

Floating marine algal mats and other types of algae that occur on the sea surface in the Offshore Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae (Schoener and Rowe 1970) and would, therefore, not impact the population. This disturbance would have no impact on marine algae. These stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish); for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

Therefore, military expended materials used for training activities under Alternative 1 are not expected to pose a risk to marine algae because (1) the relative coverage of marine algae in the Offshore Area is low, (2) new growth may result from marine algae exposure to military expended materials (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of military expended materials is very small relative to marine algae distribution. Based on these factors, potential impacts on marine algae from military expended materials in the Offshore Area are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts. There are no potential impacts on seagrasses.

Inland Waters

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials in the Study Area. Under Alternative 1, military expended materials would increase in the Inland Waters by 77 items as compared to the No Action Alternative. This increase is due almost entirely from EOD underwater detonations in which the military expended material consists of residue from the explosives.

Kelp, cordgrass, seagrass and other types of algae that occur on the in the Inland Waters of the Study Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. This disturbance would have no impact to marine algae. These stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish); for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

The increase in military expended materials used for training activities under Alternative 1 in the Inland Waters is not expected to pose a risk to marine algae and seagrass because (1) new growth may result from exposure to military expended materials, and (2) the impact area of military expended materials is

very small relative to marine algae and seagrass distribution. Based on these factors, potential impacts on marine algae and seagrass from military expended materials in the Inland Waters portion of the Study Area are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts.

Testing Activities

Offshore Area

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials expended under Alternative 1 in the Offshore portion of the Study Area. The numbers and footprints of military expended materials in the Offshore Area are detailed in Table 3.3-5, which mainly include sonobuoys and parachutes. Under Alternative 1 the amount of military expended materials in the Offshore Area would increase from 621 items under the No Action Alternative to 2,511 items (see Table 3.7-2).

Floating marine algal mats and other types of algae that occur on the sea surface in the Offshore Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae (Schoener and Rowe 1970) and would, therefore, not impact the population. This disturbance would have no impact on marine algae. Although these stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish), for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

Under the Alternative 1, the increased amounts of military expended materials used for testing activities in the Offshore Area are not expected to pose a risk to marine algae because (1) the relative coverage of marine algae in the Study Area is low, (2) new growth may result from marine algae exposure to military expended materials (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of military expended materials is very small relative to marine algae distribution. Based on these factors, potential impacts on marine algae in the Offshore Area from military expended materials are not expected to result in detectable changes in its growth, survival, or propagation, and are not expected to result in population-level impacts. There are no potential impacts on seagrass.

Inland Waters

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials; the numbers and footprints of military expended materials in the Inland Waters of the Study Area are detailed in Table 3.3-6.

Under Alternative 1, a small increase in military expended materials occurs for testing activities from the No Action Alternative. The increase in military expended materials is associated with Naval Undersea Warfare Center Division, Keyport and Naval Surface Warfare Center, Carderock Division Detachment Puget Sound testing activities.

Kelp, cordgrass, seagrass and other types of algae that occur on the in the Inland Waters of the Study Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. This disturbance would have no impact to marine algae. These stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish); for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

The minimal increase in military expended materials used for testing activities under Alternative 1 in the Inland Waters is not expected to pose a risk to marine algae and seagrass because (1) new growth may result from exposure to military expended materials, and (2) the impact area of military expended materials is very small relative to marine algae and seagrass distribution. Based on these factors, potential impacts on marine algae and seagrass from military expended materials in the Inland Waters portion of the Study Area are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts.

Western Behm Canal, Alaska

No testing activities with military expended materials are proposed in the southeast Alaska portion of the Study Area under the Alternative 1.

3.7.3.2.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, military expended materials would increase by approximately 4 percent as compared to the No Action Alternative, the same increase as described above in Section 3.7.3.2.2.2 (Alternative 1). Therefore, impacts from military expended materials under Alternative 2 would be the same as under Alternative 1.

Inland Waters

Under Alternative 2, military expended materials would increase in the Inland Waters by 77 items as compared to the No Action Alternative, the same as described above in Section 3.7.3.2.2.2 (Alternative 1). Therefore, impacts from military expended materials under Alternative 2 would be the same as under Alternative 1.

Testing Activities

Offshore Area

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials. The numbers and footprints of military expended materials in the Offshore Area are detailed in Table 3.3-5, which mainly includes sonobuoys and parachutes. Under Alternative 2 the number of military expended materials in the Offshore Area would increase from 621 items under the No Action Alternative to 2,764 items.

Floating marine algal mats and other types of algae that occur on the sea surface in the Offshore Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. If enough military expended materials land on algal mats, the mats can sink, but sinking occurs as a natural part of the aging process of marine algae (Schoener and Rowe 1970) and would, therefore, not impact the population. This disturbance would have no impact on marine algae. Although these stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish), for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

Under the Alternative 2, the increased amounts of military expended materials used for testing activities in the Offshore Area are not expected to pose a risk to marine algae because (1) the relative coverage of marine algae in the Study Area is low, (2) new growth may result from marine algae exposure to military expended materials (see Section 3.7.3.1.1, Impacts from Underwater Explosives), and (3) the impact area of military expended materials is very small relative to marine algae distribution. Based on these

factors, potential impacts on marine algae in the Offshore Area from military expended materials are not expected to result in detectable changes in its growth, survival, or propagation, and are not expected to result in population-level impacts. There are no potential impacts on seagrass.

Inland Waters

Tables 3.0-20 through 3.0-22 and Tables 3.0-25 through 3.0-28 list the numbers and locations of military expended materials. The numbers and footprints of military expended materials in the Inland Waters of the Study Area are detailed in Table 3.3-6.

Under Alternative 2, there is a small increase in military expended materials for testing activities under Alternative 2 from the No Action Alternative (see Table 3.7-2).

Kelp, cordgrass, seagrass and other types of algae that occur in the Inland Waters of the Study Area may be temporarily disturbed by military expended materials. This type of disturbance would not likely be different from conditions created by waves or rough weather. This disturbance would have no impact to marine algae. These stressors may impact the organisms that inhabit marine algae (e.g., sea turtles, birds, marine invertebrates, and fish); for analysis of potential impacts to the species that inhabit marine algae, see Sections 3.5, 3.6, 3.8, and 3.9.

The minimal increase in military expended materials used for testing activities under Alternative 2 in the Inland Waters is not expected to pose a risk to marine algae and seagrass because (1) new growth may result from exposure to military expended materials, and (2) the impact area of military expended materials is very small relative to marine algae and seagrass distribution. Based on these factors, potential impacts on marine algae and seagrass from military expended materials in the Inland Waters portion of the Study Area are not expected to result in detectable changes in their growth, survival, or propagation, and are not expected to result in population-level impacts.

Western Behm Canal, Alaska

No training or testing activities with military expended materials are proposed in the southeast Alaska portion of the Study Area under Alternative 2.

3.7.3.2.2.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Military Expended Materials (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, military expended materials used for training and testing activities may adversely affect EFH by reducing the quality and quantity of marine vegetation that constitutes EFH or Habitat Areas of Particular Concern. Any impacts of military expended materials on attached macroalgae or submerged rooted vegetation would be minimal and long term.

3.7.3.2.3 Impacts from Seafloor Devices

Four training and testing activities include the use of seafloor devices—items that may contact the ocean bottom temporarily. The activities and the specific seafloor devices are: (1) precision anchoring training, where anchors are lowered to the seafloor and recovered; (2) EOD mine countermeasures training exercises, where some mine targets may be moored to the seafloor; (3) crawler UUV tests in which UUVs “crawl” across the seafloor; and (4) various testing activities where small anchors are placed on the seafloor to hold instrumentation in place. Marine vegetation on the seafloor may be impacted by seafloor devices, while vegetation on the sea surface such as marine algal mats and single-celled algae

are not likely to be impacted and will not be discussed further. Seagrasses and seafloor macroalgae in the Study Area may be impacted by the use of seafloor devices.

Seafloor device operation or removal could impact seagrass by physically removing vegetation (e.g., uprooting), crushing the vegetation, temporarily increasing the turbidity (sediment suspended in the water) of waters nearby, or shading seagrass, which may interfere with photosynthesis. If seagrass is not able to photosynthesize, its ability to produce energy is compromised. Seagrasses occur in all areas where seafloor devices are operated, except for the surf zone area of the Quinault Range Site in the Offshore Area.

Training activities involving seafloor devices occur only in the Inland Waters, so the Offshore Area will not be analyzed under training activities.

3.7.3.2.3.1 No Action Alternative

Training Activities

Inland Waters

Two EOD mine countermeasure exercises would occur each year in the Inland Waters under the No Action Alternative. These two activities could occur at either the Hood Canal EOD Training Range or the Crescent Harbor EOD Training Range. Not every activity would include a bottom-moored mine, as some exercises involve only a floating mine shape.

Eelgrass could be present where the mine countermeasure training activity takes place. Seafloor devices may impact vegetation in benthic habitats, but the impacts would be temporary (not permanent) and would be followed by rapid (within a few weeks) recovery. Eelgrass beds show signs of recovery after a cessation of physical disturbance; the rate of recovery is a function of the severity of the disturbance (Neckles et al. 2005). The main factors that contribute to eelgrass recovery include improving water quality and cessation of major disturbance activities (Chavez 2009). Bottom-moored mine shapes would have a minor impact limited to the area of the actual footprint of the mooring (approximately 1 $ft.^2$ [0.1 m^2]).

Seafloor device use in shallow water habitats under the No Action Alternative training activities would pose a negligible risk to marine vegetation. Any damage from seafloor devices would be followed by a rapid recovery period lasting weeks. Population-level impacts are unlikely because of the small, local impact areas, the limited frequency of training activities, and the wider geographic distribution of seagrasses in and adjacent to training areas.

Testing Activities

Offshore Area

Five crawler UUV testing activities would occur in the Offshore Area under the No Action Alternative. Because of the absence of marine vegetation in the surf zone area where the testing occurs, and the infrequency of testing, impacts to marine vegetation are unlikely.

Inland Waters

As shown in Table 3.7-2, 210 annual testing activities would occur in the Inland Waters under the No Action Alternative. These activities could include the use of small anchors or crawler UUVs.

Eelgrass could be present where these testing activities take place. Marine vegetation could be affected by the use of seafloor devices (e.g., anchors, targets, and crawler UUVs). However, these effects would

be short term, would affect a very small portion of the Study Area (several yards at most), and would not result in long-term changes in the distribution or abundance of these populations. Activities usually last less than a day and are localized within a small area. Given that the size of the disturbed area would be small (several yards at most) and the activities would be short term and infrequent, impacts would be negligible. In addition, the disturbed area would likely be re-colonized within a relatively short time (a few weeks) as the disturbed sediments would not be removed, but rather redistributed in the same location. Therefore, there would be minimal impacts to marine vegetation with the implementation of the No Action Alternative within the Inland Waters.

Western Behm Canal, Alaska

No testing activities with seafloor devices are proposed in the Western Behm Canal, Alaska, portion of the Study Area under the No Action Alternative.

3.7.3.2.3.2 Alternative 1

Training Activities

Inland Waters

Under Alternative 1, the total number of explosive training events would increase relative to the No Action Alternative, due to the additional use of 18 SWAG in Crescent Harbor and 18 SWAG in Hood Canal. The mine neutralization exercises would increase from two 1.5 lb. mine neutralization charges to three 2.5 lb. charges in Hood Canal and from two to three 2.5 lb. mine neutralization exercises in Crescent Harbor. Not every activity would include a bottom-moored mine, as some exercises involve only a floating mine shape.

In addition, 10 precision anchoring training exercises would occur, in two locations within the Inland Waters: (1) a general anchorage area at Naval Station Everett, and (2) an anchorage area at Indian Island.

Eelgrass could be present at all of these locations. For the same reasons as described under the No Action Alternative, these activities would pose a negligible risk to marine vegetation. Any damage from anchors would be followed by a recovery period lasting weeks to months. Population-level impacts are unlikely because of the small, local impact areas; the limited frequency of training activities; and the wider geographic distribution of seagrasses in and adjacent to training areas.

Testing Activities

Offshore Area

Six crawler UUV testing activities would occur in the Offshore Area under Alternative 1, an increase of one over the No Action Alternative. Because of the absence of marine vegetation in the surf zone area where the testing occurs, and the frequency of testing, impacts to marine vegetation are unlikely.

Inland Waters

As shown in Table 3.7-2, 225 annual testing activities would occur in the Inland Waters under Alternative 1, an increase of 15 over the No Action Alternative. These activities are of the same type in the same locations as described under the No Action Alternative.

Eelgrass could be present where these testing activities take place. For the same reasons as described under the No Action Alternative, and re-colonization would likely occur within a relatively short time (weeks). Therefore, there would be minimal impacts to marine vegetation with the implementation of Alternative 1 within the Inland Waters.

Western Behm Canal, Alaska

Under Alternative 1, five component system testing activities would occur in the Western Behm Canal. These activities involve the temporary placement of small anchoring devices on the seafloor.

Eelgrass could be present where these testing activities take place. Marine vegetation could be affected by the use of these anchors. However, these effects would be short term (weeks), would affect a very small portion of the area (several yards at most), and would not result in long-term changes in the distribution or abundance of these populations. Activities usually last less than a day and are localized within a small area. Given that the size of the disturbed area would be small (several yards at most) and the activities would be short term and infrequent, impacts would be minimal. In addition, the disturbed area would likely be re-colonized within a relatively short time as the disturbed sediments would not be removed, but rather re-distributed in the same location. Therefore, there would be minimal impacts to marine vegetation with the implementation of Alternative 1 in the Western Behm Canal.

3.7.3.2.3.3 Alternative 2

Training Activities

Inland Waters

Under Alternative 2, the total number of explosive training events would increase relative to the No Action Alternative, due to the additional use of 18 SWAG in Crescent Harbor and 18 SWAG in Hood Canal. The mine neutralization exercises would increase from two 1.5 lb. mine neutralization charges to three 2.5 lb. charges in Hood Canal and from two to three 2.5 lb. mine neutralization exercises in Crescent Harbor. Not every activity would include a bottom-moored mine, as some exercises involve only a floating mine shape. This level and type of activity is the same as described for Alternative 1.

In addition, 10 precision anchoring training exercises would occur at the same locations and in the same manner as described above under Alternative 1.

Eelgrass could be present at all of these locations. For the same reasons as described under the No Action Alternative, these activities would pose a negligible risk to marine vegetation. Any damage from anchors would be followed by a recovery period lasting weeks to months. Population-level impacts are unlikely because of the small, local impact areas, the frequency of training activities, and the wider geographic distribution of seagrasses in and adjacent to training areas.

Testing Activities

Offshore Area

Seven crawler UUV testing activities would occur in the Offshore Area under Alternative 2, an increase of two over the No Action Alternative. Because of the absence of marine vegetation in the surf zone area where the testing occurs, and the infrequency of testing, impacts to marine vegetation are unlikely.

Inland Waters

As shown in Table 3.7-2, 239 annual testing activities would occur in the Inland Waters under Alternative 2, an increase of 29 over the No Action Alternative. These activities are of the same type in the same locations as described under the No Action Alternative.

Eelgrass could be present where these testing activities take place. For the same reasons as described under the No Action Alternative, re-colonization would likely occur within a relatively short time. Therefore, there would be minimal impacts to marine vegetation with the implementation of Alternative 2 within the Inland Waters.

Western Behm Canal, Alaska

Under Alternative 2, 15 component system testing activities would occur in the Western Behm Canal, an increase of 10 over the No Action Alternative. These activities involve the temporary placement of small anchoring devices on the seafloor.

Eelgrass could be present where these testing activities take place. For the same reasons as described under the No Action Alternative, re-colonization would likely occur within a relatively short time. Therefore, there would be minimal impacts to marine vegetation with the implementation of Alternative 2 in the Western Behm Canal.

3.7.3.2.3.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Seafloor Devices (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of seafloor devices during training and testing activities may adversely affect EFH by reducing the quality or quantity of attached macroalgae and submerged rooted vegetation that constitutes EFH or Habitat Areas of Particular Concern. Any impacts of seafloor devices on attached macroalgae or submerged rooted vegetation would be minimal and short term.

3.7.3.3 Secondary Stressors

This section analyzes potential impacts on marine vegetation exposed to stressors indirectly through changes in sediments and water quality. Section 3.1 (Sediments and Water Quality) considered the impacts on marine sediments and water quality from explosives and explosion by-products, metals, chemicals other than explosives, and other materials (marine markers, flares, chaff, targets, and miscellaneous components of other materials). The analysis determined that neither state or federal standards or guidelines for sediments nor water quality would be violated by the No Action Alternative, Alternative 1, or Alternative 2. Because of these conditions, population-level impacts on marine vegetation are likely to be inconsequential and undetectable. Therefore, because these standards and guidelines are structured to protect human health and the environment, and the proposed activities do not violate them, no indirect impacts are anticipated on marine vegetation from the training and testing activities proposed by the No Action Alternative, Alternative 1, or Alternative 2.

3.7.3.4 Summary of Potential Impacts (Combined Impacts of All Stressors) on Marine Vegetation

Activities described in this Environmental Impact Statement (EIS)/Overseas EIS that have potential impacts on vegetation are widely dispersed, and not all stressors would occur simultaneously in a given location. The stressors that have potential impacts on marine vegetation include acoustic (underwater and surface explosions) and physical disturbances or strikes (vessel and in-water devices, and military expended materials). Unlike mobile organisms, vegetation cannot flee from stressors once exposed. Marine algae are the vegetation most likely to be exposed to multiple stressors in combination because it occurs in large expanses. Discrete areas of the Study Area (mainly within offshore areas with depths greater than 26 m (85.3 ft.) in portions of range complexes and testing ranges) could experience higher levels of activity involving multiple stressors, which could result in a higher potential risk for impacts on marine algae within those areas. The potential for exposure of seagrasses and attached macroalgae to multiple stressors would be less because activities are not concentrated in coastal (areas with depths less than 26 m) distributions of these species. The combined impacts of all stressors would not be expected to affect marine vegetation populations because (1) activities involving more than one stressor are generally short in duration, (2) such activities are dispersed throughout the Study Area, and (3) activities are generally scheduled where previous activities have occurred. The aggregate effect on marine vegetation would not observably differ from existing conditions.

3.7.3.4.1 Essential Fish Habitat Determinations

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of metal, chemical, and other material contaminants during training and testing activities would have no adverse impact on marine vegetation that constitutes EFH or Habitat Areas of Particular Concern. The use of explosives and other impulse sources, vessel movement, in-water devices, military expended materials, and seafloor devices during training and testing activities may adversely affect EFH by reducing the quality and quantity of marine vegetation that constitutes EFH or Habitat Areas of Particular Concern. Individual stressor impacts on marine vegetation were either no effect or minimal and ranged in duration from temporary to long term, depending on the habitat impacted.

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3.8 Marine Invertebrates

TABLE OF CONTENTS

3.8 MARINE INVERTEBRATES 3.8-1
3.8.1 INTRODUCTION 3.8-2
3.8.2 AFFECTED ENVIRONMENT 3.8-2
3.8.2.1 Taxonomic Groups 3.8-3
3.8.2.2 Invertebrate Hearing and Vocalization 3.8-4
3.8.2.3 General Threats 3.8-5
3.8.2.4 Endangered Species Act-Listed Species 3.8-6
3.8.2.5 Federally Managed Species 3.8-6
3.8.2.6 Taxonomic Group Descriptions and Distributions 3.8-7
3.8.3 ENVIRONMENTAL CONSEQUENCES 3.8-19
3.8.3.1 Acoustic Stressors 3.8-21
3.8.3.2 Energy Stressors 3.8-36
3.8.3.3 Physical Disturbance and Strike 3.8-38
3.8.3.4 Entanglement Stressors 3.8-51
3.8.3.5 Ingestion Stressors 3.8-58
3.8.3.6 Secondary Stressors 3.8-62
3.8.4 SUMMARY OF POTENTIAL IMPACTS (COMBINED IMPACTS OF ALL STRESSORS) ON MARINE INVERTEBRATES . 3.8-66
3.8.4.1 Combined Impacts of All Stressors 3.8-66
3.8.4.2 Essential Fish Habitat Determinations 3.8-67

LIST OF TABLES

TABLE 3.8-1: TAXONOMIC GROUPS OF MARINE INVERTEBRATES IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.8-3
TABLE 3.8-2: STRESSORS FOR MARINE INVERTEBRATES IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.8-19

LIST OF FIGURES

FIGURE 3.8-1: CHLOROPHYLL CONCENTRATIONS IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.8-8
FIGURE 3.8-2: DEEP-SEA CORALS IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.8-12
FIGURE 3.8-3: PREDICTION OF DISTANCE TO 90 PERCENT SURVIVABILITY OF MARINE INVERTEBRATES EXPOSED TO UNDERWATER EXPLOSIONS (YOUNG 1991) 3.8-31

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3.8 MARINE INVERTEBRATES

MARINE INVERTEBRATES SYNOPSIS

The United States Department of the Navy considered all potential stressors and the following have been analyzed for marine invertebrates:

- Acoustic (sonar and other active acoustic sources, underwater explosives)
- Energy (electromagnetic devices)
- Physical disturbance and strike (vessels and in-water devices, strikes, military expended materials, and seafloor devices)
- Entanglement (fiber optic cables and guidance wires, parachutes)
- Ingestion (munitions and military expended materials other than munitions)
- Secondary stressors (metals and chemicals)

Preferred Alternative (Alternative 1)

- No Endangered Species Act-listed marine invertebrate species are found in the Northwest Training and Testing Study Area.
- Acoustic: The use of sonar and other active acoustic sources, and underwater explosives is not expected to result in detectable changes in growth, survival, propagation, or population-level impacts.
- Energy: The use of electromagnetic devices is not expected to result in detectable changes in growth, survival, propagation, or population-level impacts.
- Physical Disturbance and Strike: The use of vessels, in-water devices, military expended materials, and seafloor devices is not expected to result in detectable changes in growth, survival, propagation, or population-level impacts.
- Entanglement: The use of fiber optic cables and guidance wires and parachutes is not expected to result in detectable changes in growth, survival, propagation, or population-level impacts.
- Ingestion: The use of munitions and military expended materials other than munitions is not expected to result in detectable changes in growth, survival, propagation, or population-level impacts.
- Secondary: Secondary impacts to marine invertebrates would be inconsequential and not detectable.
- Pursuant to the Essential Fish Habitat (EFH) requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other acoustic sources, vessel noise, weapons firing noise, electromagnetic sources, vessel movement, in-water devices, and metal, chemical, or other material contaminants will have no adverse effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The use of electromagnetic sources will have minimal and temporary adverse impact to invertebrates occupying water column EFH or Habitat Areas of Particular Concern. The use of explosives, military expended materials, seafloor devices, and explosives and explosive byproduct contaminants may have an adverse effect on EFH by reducing the quality and quantity of sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern.

3.8.1 INTRODUCTION

In this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), marine invertebrates are evaluated based on their distribution and life history relative to the stressor or activity being considered. Activities are evaluated for their potential impact on marine invertebrates in general, and are evaluated by taxonomic and regulatory groupings as appropriate.

Invertebrates are animals without backbones, and marine invertebrates are a large, diverse group of at least 150,000 species inhabiting the marine environment (Brusca and Brusca 2003). Many of these species are important to humans ecologically and economically, providing essential ecosystem services (coastal protection) and income from tourism and commercial and recreational fisheries (Spalding et al. 2001; Anderson et al. 2011). Because marine invertebrates occur in all habitats, activities that affect the water column or the seafloor could impact numerous zooplankton (tiny animals found near the surface of the water column that drift along with currents), eggs, larvae, larger invertebrates living in the water column, and benthic invertebrates that live on or in the seafloor. The greatest densities of marine invertebrates are usually on the seafloor (Sanders 1968); therefore, activities that contact the seafloor have a greater potential for impact.

The following subsections briefly introduce federally managed species, habitat types, and major taxonomic groups of marine invertebrates in the Study Area. Although there are no Endangered Species Act (ESA) listed species in the Study Area, some species are considered candidates for ESA listing, and were assessed. Federally managed marine invertebrate species regulated under the Magnuson-Stevens Fishery Conservation and Management Act are described in the Northwest Training and Testing (NWTT) Essential Fish Habitat Assessment (EFHA), and conclusions from the EFHA will be summarized in each substressor section. The National Oceanic and Atmospheric Administration Fisheries Office of Protected Resources maintains a website that provides additional information on the biology, life history, species distribution (including maps), and conservation of invertebrates.

3.8.2 AFFECTED ENVIRONMENT

Marine invertebrates live in all of the world's oceans, from warm shallow waters to cold deep waters. They inhabit the seafloor and water column in all of the large marine ecosystems and open-ocean areas in the Study Area. Marine invertebrate distribution in the Study Area is influenced by habitat, ocean currents, and water quality factors such as temperature, salinity, acidity (ocean acidification), and nutrient content (Levinton 2009). The distribution of invertebrates is also influenced by their distance from the equator (latitude); in general, the number of marine invertebrate species increases toward the equator (Macpherson 2002). The higher number of species (diversity) and abundance of marine invertebrates in coastal habitats, compared with the open ocean, is a result of more nutrient availability from terrestrial environments and the variety of habitats and substrates found in coastal waters (Levinton 2009).

Marine invertebrates in the Study Area inhabit coastal waters and benthic habitats, including salt marshes, kelp forests, soft sediments, canyons, and the continental shelf. Salt marsh invertebrates include oysters, crabs, and worms that are important prey for birds and small mammals. Mudflats provide habitat for substantial amounts of crustaceans, bivalves, and worms. The sandy intertidal area is dominated by species that are highly mobile and can burrow. Some of the most common invertebrates found in sandy intertidal areas in the Olympic Coast National Marine Sanctuary are razor clams (*Siliqua patula*), Dungeness crabs (*Cancer magiste*), sea pens (*Ptilosarcus gurneyi*), smooth bay shrimp (*Crangon stylirostris*), Lewis's moonsnails (*Euspira lewisii*), and rainbow stars (*Orthasterias koehlen*) (National

Marine Sanctuaries 2004). One of the most abundant invertebrates found in the near shore areas of the Study Area on soft sediments are geoduck clams (*Panopea generosa*).

3.8.2.1 Taxonomic Groups

All marine invertebrate taxonomic groups are represented in the NWTT Study Area (Study Area). Major invertebrate phyla (taxonomic range)—those with greater than 1,000 species (Appeltans et al. 2010)—and the general zones they inhabit in the Study Area are listed in Table 3.8-1. Throughout the marine invertebrate section, organisms may be referred to by their phylum name or, more generally, as marine invertebrates.

Table 3.8-1: Taxonomic Groups of Marine Invertebrates in the Northwest Training and Testing Study Area

Major Invertebrate Groups[1]		Presence in Study Area		
Common Name (Species Group)	**Description**	**Offshore**	**Inland Waters**	**Western Behm Canal, Alaska**
Foraminifera, radiolarians, ciliates (Phylum Foraminifera)	Benthic and pelagic single-celled organisms; shells typically made of calcium carbonate or silica.	Water column, seafloor	Water column, seafloor	Water column, seafloor
Sponges (Phylum Porifera)	Benthic animals; large species have calcium carbonate or silica structures embedded in cells to provide structural support.	Seafloor	Seafloor	Seafloor
Corals, hydroids, jellyfish (Phylum Cnidaria)	Benthic and pelagic animals with stinging cells.	Water column, seafloor	Water column, seafloor	Water column, seafloor
Flatworms (Phylum Platyhelminthes)	Mostly benthic; simplest form of marine worm with a flattened body.	Water column, seafloor	Water column, seafloor	Water column, seafloor
Ribbon worms (Phylum Nemertea)	Benthic marine worms with a long extension from the mouth (proboscis) from the mouth that helps capture food.	Water column, seafloor	Seafloor	Seafloor
Round worms (Phylum Nematoda)	Small benthic marine worms; many live in close association with other animals (typically as parasites).	Water column, seafloor	Water column, seafloor	Water column, seafloor
Segmented worms (Phylum Annelida)	Mostly benthic, highly mobile marine worms; many tube-dwelling species.	Seafloor	Seafloor	Seafloor
Bryozoans (Phylum Bryozoa)	Lace-like animals that exist as filter feeding colonies attached to the seafloor and other substrates.	Seafloor	Seafloor	Seafloor
Cephalopods, bivalves, sea snails, chitons (Phylum Molluska)	Mollusks are a diverse group of soft-bodied invertebrates with a specialized layer of tissue called a mantle. Mollusks such as squid are active swimmers and predators, while others such as sea snails are predators or grazers and clams are filter feeders.	Water column, seafloor	Water column, seafloor	Water column, seafloor

Major Invertebrate Groups[1]		Presence in Study Area		
Common Name (Species Group)	**Description**	**Offshore**	**Inland Waters**	**Western Behm Canal, Alaska**
Shrimp, crab, barnacles, copepods (Phylum Arthropoda - Crustacea)	Benthic or pelagic; some are immobile; with an external skeleton; all feeding modes from predator to filter feeder.	Water column, seafloor	Water column, seafloor	Water column, seafloor
Sea stars, sea urchins, sea cucumbers (Phylum Echinodermata)	Benthic predators and filter feeders with tube feet.	Seafloor	Seafloor	Seafloor

[1] Major species groups (those with more than 1,000 species) are based on the World Register of Marine Species (Appeltans et al. 2010) and Catalogue of Life (Bisby et al. 2010)
Notes: Benthic = A bottom-dwelling organism; Pelagic = relating to, living, or occurring in the waters of the ocean.

3.8.2.2 Invertebrate Hearing and Vocalization

Very little is known about sound detection and use of sound by aquatic invertebrates (Budelmann 2010; Montgomery et al. 2006; Popper et al. 2001). Organisms may detect sound by sensing either the particle motion or pressure component of sound, or both. Aquatic invertebrates probably do not detect pressure since many are generally the same density as water and few, if any, have air cavities that would function like the fish swim bladder in responding to pressure (Budelmann 2010; Popper et al. 2001). Many aquatic invertebrates, however, have ciliated “hair” cells that may be sensitive to water movements, such as those caused by currents or water particle motion very close to a sound source (Budelmann 2010). These cilia may allow invertebrates to sense nearby prey or predators or help with local navigation.

Aquatic invertebrates that can sense local water movements with ciliated cells include cnidarians, flatworms, segmented worms, urochordates (tunicates), mollusks, and arthropods (Budelmann 2010; Popper et al. 2001). The sensory capabilities of corals are largely limited to detecting water movement using receptors on their tentacles (Gochfeld 2004), and the exterior cilia of coral larvae likely help them detect nearby water movements (Vermeij et al. 2010). Some aquatic invertebrates have specialized organs called statocysts for the determination of equilibrium and, in some cases, linear or angular acceleration. Statocysts allow an animal to sense movement, and may enable some species, such as cephalopods and crustaceans, to be sensitive to water particle movements associated with sound (Hu et al. 2009; Kaifu et al. 2008; Montgomery et al. 2006; Popper et al. 2001). Because any acoustic sensory capabilities, if present at all, are limited to detecting water motion, and water particle motion near a sound source falls off rapidly with distance, aquatic invertebrates are probably limited to detecting nearby sound sources rather than sound caused by pressure waves from distant sources.

Both behavioral and auditory brainstem response studies suggest that crustaceans may sense sounds up to three kilohertz (kHz), but best sensitivity is likely below 200 Hertz (Hz) (Lovell et al. 2005; Lovell et al. 2006; Goodall et al. 1990). Most cephalopods (e.g., octopus and squid) likely sense low-frequency sound below 1,000 Hz, with best sensitivities at lower frequencies (Budelmann 2010; Mooney et al. 2010; Packard et al. 1990). A few cephalopods may sense higher frequencies up to 1,500 Hz (Hu et al. 2009). in a study, squid did not respond to toothed whale ultrasonic echolocation clicks at sound pressure levels ranging from 199 to 226 decibels (dB) referenced to (re) 1 micropascal (µPa) peak-to-peak, likely because these clicks were outside of squid hearing range (Andre et al. 2011).

Aquatic invertebrates may produce and use sound in territorial behavior, to deter predators, to find a mate, and to pursue courtship (Popper et al. 2001). Some crustaceans produce sound by rubbing or closing hard body parts together, such as lobsters and snapping shrimp (Latha et al. 2005; Patek and Caldwell 2006). The snapping shrimp chorus makes up a significant portion of the ambient noise budget in many locales (Cato and Bell 1992). Each click is up to 215 dB re 1 µPa, with a peak around 2–5 kHz (Heberholz and Schmitz 2001). Other crustaceans, such as the California spiny lobster (*Panulirus interruptus*), make low-frequency rasping or rumbling noises, perhaps used in defense or territorial display, that are often obscured by ambient noise (Patek and Caldwell 2006; Patek et al. 2009).

Reef noises, such as fish pops and grunts, sea urchin grazing (around 1.0–1.2 kHz), and snapping shrimp noises (around 5 kHz) (Radford et al. 2010), may be used as a cue by some aquatic invertebrates. Nearby reef noises were observed to affect movements and settlement behavior of coral and crab larvae (Jeffs et al. 2003; Radford et al. 2010; Stanley et al. 2010; Vermeij et al. 2010). Larvae of other crustacean species, including pelagic and nocturnally emergent species that benefit from avoiding coral reef predators, appear to avoid reef noises (Simpson et al. 2011). Detection of reef noises is likely limited to short distances (less than 330 ft. [101 m]) (Vermeij et al. 2010).

3.8.2.3 General Threats

General threats to marine invertebrates include overexploitation and destructive fishing practices (Jackson et al. 2001; Miloslavich et al. 2011; Pandolfi et al. 2003), habitat degradation from pollution and coastal development (Cortes and Risk 1985; Downs et al. 2009), disease, and invasive species (Bryant et al. 1998; Galloway et al. 2009; National Marine Fisheries Service 2010; Wilkinson 2002). These threats are compounded by global threats to marine life, including the increasing temperature and decreasing pH of the ocean from pollution linked to global climate change (Cohen et al. 2009; Miloslavich et al. 2011).

In the Study Area, some marine invertebrates that are managed to ensure their sustainable harvest, have been used as characteristics to define groundfish essential fish habitat, which is designated by National Marine Fisheries Service (NMFS) and regional fishery management councils. The sustainability and abundance of these organisms are vital to the marine ecosystem and to the sustainability of the world's commercial fisheries (Pauly et al. 2002). Marine invertebrates are harvested for food and for the aquarium trade. Economically important invertebrate groups that are fished, commercially and recreationally, for food in the United States are crustaceans (e.g., shrimps, lobsters, and crabs), bivalves (e.g., scallops, clams, and oysters), and cephalopods (e.g., squid and octopuses) (Morgan and Chuenpagdee 2003; Pauly et al. 2002). These fisheries are a key part of the commercial fisheries industry in the United States (Food and Agriculture Organization of the United Nations 2005). Global threats to crustaceans, bivalves, and cephalopods are largely the result of overfishing, destructive fishing techniques (e.g., trawling) and habitat modification (Morgan and Chuenpagdee 2003; Pauly et al. 2002). A relatively new threat to invertebrates is bioprospecting, the collection of organisms in pursuit of new compounds for pharmaceutical products (see additional information in Section 3.8.2.6.8, Bryozoans [Phylum Bryozoa]).

Additional information on the biology, life history, and conservation of marine invertebrates can be found on the websites maintained by the following organizations:

- NMFS, particularly for ESA-listed species, species of concern, and candidate species
- United States (U.S.) Coral Reef Task Force
- MarineBio Conservation Society
- Monterey Bay Aquarium

The discussion above represents general threats to marine invertebrates. Additional threats to individual species within the Study Area are described below in the accounts of those species. The following sections include descriptions of species considered candidates for ESA listing, and descriptions of the major marine invertebrate taxonomic groups in the Study Area. These taxonomic group descriptions include descriptions of key habitat-forming invertebrates, including reef-forming sponges, corals and other organisms that define live hardbottom, reef-building worms, oysters, and other reef-building mollusks.

3.8.2.4 Endangered Species Act-Listed Species

3.8.2.4.1 Offshore Area

There are no marine invertebrates in the Offshore Area of the Study Area listed as threatened or endangered under the ESA.

3.8.2.4.2 Inland Waters

There are no marine invertebrates in the Inland Waters of the Study Area listed as threatened or endangered under the ESA; however, three species are listed as species of concern, the Pinto abalone (*Haliotis kamtschatkana*), the Olympia oyster (*Ostreola conchaphila*), and the Newcomb's littorine snail (*Algamorda subrotundata*). There are some concerns regarding status and threats for species of concern, but insufficient information is available to indicate a need to list the species under the ESA. Species of concern status does not carry any procedural or substantive protections under the ESA.

3.8.2.4.3 Western Behm Canal, Alaska

There are no marine invertebrates in the Western Behm Canal portion of the Study Area listed as threatened or endangered under the ESA; however, three species are listed as species of concern, the Pinto abalone (*Haliotis kamtschatkana*), the Olympia oyster (*Ostreola conchaphila*), and the Newcomb's littorine snail (*Algamorda subrotundata*). There are some concerns regarding status and threats for species of concern, but insufficient information is available to indicate a need to list the species under the ESA. Species of concern status does not carry any procedural or substantive protections under the ESA.

3.8.2.5 Federally Managed Species

Federally managed species are species whose harvest and protection are overseen by a federal management council for conservation and as a benefit to the nation. In the context of federally managed species, the term "fishery" applies to any biologically generated object extracted from the ocean (e.g., there is a crab "fishery" even though the animals are not fish).

3.8.2.5.1 Offshore Area

One federally managed species of marine invertebrate is found in the Offshore Area of the Study Area: the market squid (*Loligo opalescens*). Assessments in Section 3.8.3 (Environmental Consequences) combine federally managed species with the rest of their taxonomic group, unless impacts or differential effects warrant separate treatment. The analysis of impacts on commercial and recreational fisheries is provided in Section 3.12 (Socioeconomics).

3.8.2.5.2 Inland Waters

One of the federally managed species of marine invertebrates in the Inland Waters portion of the Study Area is the market squid (*Loligo opalescens*). Assessments in Section 3.8.3 (Environmental

Consequences) combine federally managed species with the rest of their taxonomic group, unless impacts or differential effects warrant separate treatment. The analysis of impacts on commercial and recreational fisheries is provided in Section 3.12 (Socioeconomics).

3.8.2.5.3 Western Behm Canal, Alaska

Federally managed species of marine invertebrates in the Western Behm Canal portion of the Study Area include four species of scallops (*Patinopecten caurinus, Chlamys rubida, Chlamys hastata, Crassadoma gigantea*).

3.8.2.6 Taxonomic Group Descriptions and Distributions

3.8.2.6.1 Foraminiferans, Radiolarians, Ciliates (Phylum Protozoa)

Foraminiferans, radiolarians, and ciliates are minute singled-celled organisms, sometimes forming colonies of cells, belonging to the Phylum Protozoa (Castro and Huber 2000). They are found in the water column and seafloor of the world's oceans. Foraminifera form diverse and intricate shells out of calcium carbonate (Wetmore 2006). In general, the distribution of foraminiferans, radiolarians, and ciliates is patchy, occurring in regions with the optimal conditions for growth. The shells of formanifera that live in the water column eventually sink to the deep seafloor, forming sediments known as foraminiferan ooze (Wetmore 2006). Formaninfera feed on diatoms and other small organisms such as phytoplankton. Their predators include copepods and other zooplankton. Radiolarians are microscopic organisms that form glass-like shells made of silica. Radiolarian ooze covers large areas of the ocean floor (Castro and Huber 2000; Wetmore 2006). Ciliates are protozoans with small hairs (cilia) that are used to feed and for mobility (Castro and Huber 2000).

3.8.2.6.1.1 Offshore Area

In the Offshore Area, foraminiferans, radiolarians, and ciliates can be found freely floating (some are photosynthetic) and are distributed by ocean currents. The coast of the Pacific Northwest supports high primary productivity (Sutor et al. 2005). Concentrations greater than 3.0 milligrams of Chlorophyll per meter cubed (mg chl/m^3) are present throughout the spring, summer, and fall within 40 kilometers (km) (24.8 miles [mi.]) of shore, and rarely expand beyond 100 km offshore (Thomas and Strub 2001). Lowest concentrations (< 0.25 mg chl/m^3) are usually located over 200 km (124.2 mi.) offshore and intrude towards the coast in mid-summer (June to July). Each year, two episodes of seasonal bloom occur, one in spring and another in summer (Figure 3.8-1). The timing of the first of these episodes varies, occurring from early April to May. The second offshore expansion typically occurs in August (Thomas and Strub 2001).

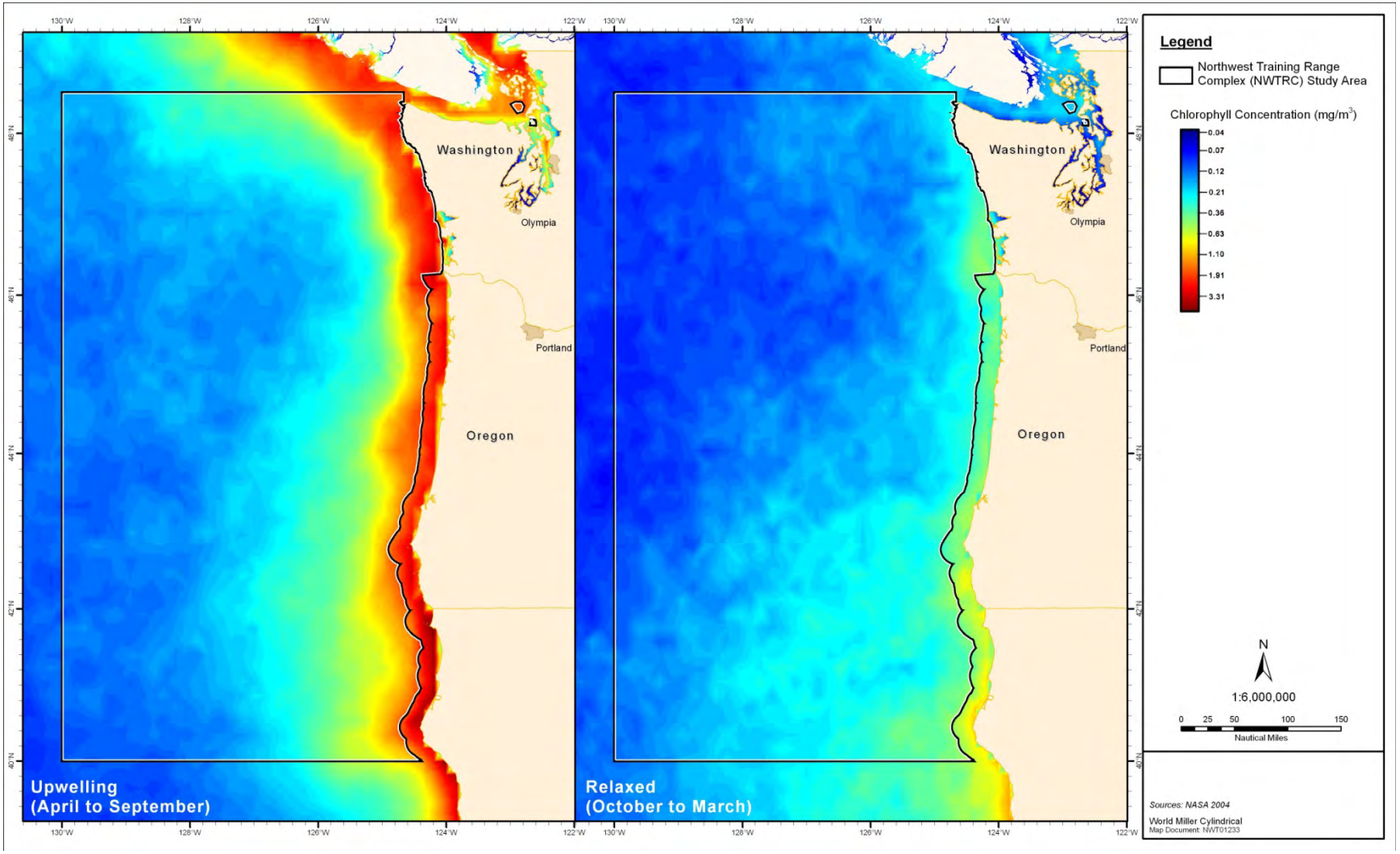

Figure 3.8-1: Chlorophyll Concentrations in the Northwest Training and Testing Study Area

Offshore, and following upwelling events along the coast, there is a dramatic shift in the composition of the phytoplankton community; the composition changes from blooms of large-sized and chain-forming diatoms in newly upwelled water along the shelf to phytoplankton communities dominated by cells < 5 microns (µm) in size (Sherr et al. 2005). At two sample stations along an upwelling front off the Oregon coast, 2–5 µm eukaryotic cells (mostly picoplankton) dominated the total phytoplankton biomass (Hood et al. 1992).

3.8.2.6.1.2 Inland Waters

Four types of protozoans are encountered in the Puget Sound: foraminiferans and radiolarians are uncommon, while dinoflagellates and ciliates are more abundant. Ciliates are the most consistently abundant protozoans in the Puget Sound (Strickland 1983).

3.8.2.6.1.3 Western Behm Canal, Alaska

In general, the concentration of phytoplankton decreases with increased distance from the shore and water depth. A study of sea surface chlorophyll concentrations for southeastern Alaska conducted in 2004 shows increased phytoplankton biomass near the Southeast Alaska Measurement Facility and other near shore areas between June and August (SALMON Project 2004). These late summer blooms of phytoplankton are triggered by wind driven vertical mixing of nutrients (Iverson et al. 1974, Ziemann et al. 1991).

3.8.2.6.2 Sponges (Phylum Porifera)

Sponges include over 8,000 marine species worldwide, and are classified in the Phylum Porifera (Appeltans et al. 2010). Sponges are bottom-dwelling, multi-cellular animals that can be best described as an aggregation of cells that perform different functions. Sponges are largely sessile (not mobile), except for their larval stages, and are common throughout the Study Area at all depths. Sponges reproduce both sexually and asexually. Water flowing through the sponge provides food and oxygen and removes wastes (Castro and Huber 2000; Collins and Waggoner 2006). Many sponges form calcium carbonate or silica spicules or bodies embedded in cells to provide structural support (Castro and Huber 2000). Sponges provide homes for a variety of animals, including shrimp, crabs, barnacles, worms, brittle stars, sea cucumbers, and other sponges (Colin and Arneson 1995d).

3.8.2.6.2.1 Offshore Area

In the Offshore Area glass or siliceous sponges (Hexactinellids) typically live in deep water (500–3,000 m) (Jamieson and Chew 2002). The hexactinellid sponges are distributed along the continental shelf and are globally unique in that they are reef-building sponges. Hexactinellid reef-building sponges are different from other hexactinellids in that their siliceous skeleton remains intact after the death of the sponge to provide a suitable framework for reef construction. The Olympic Coast National Marine Sanctuary has found deep-sea corals in depths ranging from 50 m to over 2,000 m on continental shelves, slopes, canyons, and seamounts. Olympic Coast National Marine Sanctuary research has shown corals and sponges are widely distributed but generally low density on the continental shelf off Washington (Olympic Coast National Marine Sanctuary 2012).

Other sponges in the Offshore Area include large brilliant-yellow barrel sponges that are found on seamounts (Wilson and Kaufmann 1987; Rogers 1994). In general, chemosynthetic communities in deep-water environments in the Offshore Area of the Study Area also contain sponges (Kojima 2002).

3.8.2.6.2.2 Inland Waters

In a study by Leys et al. (2004), the coastal waters of British Columbia were examined to document the glass sponge (hexactinellid) communities that inhabit the fjords. They found nine species of hexactinellid sponges that were observed on vertical or near-vertical walls and on bare rock or on rock with only a light sediment cover (Leys et al. 2004). In the Puget Sound section of the Study Area, multiple sponge communities occur. There are three sponge reef complexes that occur within the Puget Sound Study Area; these three areas all occur in the northern Puget Sound region from 90 to 210 m of water depth at North McCall Bank, South McCall Bank, and Fraser Ridge.

3.8.2.6.2.3 Western Behm Canal, Alaska

On the Alaskan and Washington State continental shelves the rockfish trawl fishery has been correlated with sponge by-catch, suggesting that sponge reefs provide important habitat for many species of fishes and invertebrates and are distributed in the southeast Alaska area and the Behm Canal (Strickland 1983; Conway et al. 2002; Whitney et al. 2005).

3.8.2.6.3 Corals, Hydroids, Jellyfish (Phylum Cnidaria)

There are over 10,000 marine species of corals, hydroids, and jellyfish worldwide (Appeltans et al. 2010). Members of this group are found throughout the Study Area at all depths. Hydroids are colonial animals similar in form to corals. Hydroids have both flexible and rigid skeletons, but are not considered to be habitat-forming (Colin and Arneson 1995a; Gulko 1998). Jellyfish are motile as larvae, sessile as an intermediate colonial polyp stage, and motile as adults (Brusca and Brusca 2003). They are predatory at all stages and, like all Cnidaria, use tentacles equipped with stinging cells to capture prey (Castro and Huber 2000; University of California at Berkeley 2010a). Jellyfish are an important prey species for a range of organisms, including some sea turtles and ocean sunfish (*Mola mola*) (Heithaus et al. 2002; James and Herman 2001).

Corals are in a class of animals that also includes anemones and soft corals. The individual unit is referred to as a polyp, and most species occur as colonies of polyps. All corals feed on small planktonic organisms or dissolved organic matter (Dubinsky and Berman-Frank 2001). Most hard corals and some soft corals are habitat forming (i.e., they form three-dimensional structures) (Freiwald et al. 2004; Spalding et al. 2001).

3.8.2.6.3.1 Offshore Area

Open-ocean or pelagic cnidarians consist of jellyfish (cnidarians), comb jellyfish (ctenophorans), hydroids, and deep sea corals. In the Offshore Area of the Study Area habitat, with increasing depth, light intensity declines and eventually algae and plants are unable to survive. Below 100 m (328.1 feet [ft.]) a few, small, stony corals are found, along with deep-sea corals that lack symbiotic algae (zooxanthellae) and instead take in plankton and organic matter for their energy needs (Chave and Malahoff 1998, Olympic Coast National Marine Sanctuary 2012). Headlands are also common along the open rocky coasts of the Pacific Northwest and are very similar in habitat to islets (Proctor et al. 1980). Islets and headlands along the Pacific coast are high-energy, unique habitats (Airamé et al. 2003).

Deep-sea coral communities are found along the entire continental slope of the Offshore Area of the Study Area (Figure 3.8-2).While the mean depth range of deep-sea corals in the Northeast Pacific Ocean is 265–1,262 m (869.4–4,140.4 ft.), deep-sea corals of the Study Area occur in water depths ranging from 9 to 3,450 m (29.5 to 11,318.9 ft.) (Etnoyer and Morgan 2003). At greater depths, animals, including non-reef-building corals, obtain their food through suspension feeding. The most common

invertebrates found on seamounts worldwide are cnidarians (i.e., hydroids, jellyfish, anemones, and corals) (Wilson and Kaufmann 1987, Rogers 1994).

True deep-sea coral communities live in complete darkness, in temperatures as low as 4°C and in waters as deep as 6,000 m (19,685 ft.) in the Offshore Area of the Study Area. Fifteen such forms of corals occur in the Offshore Area. These communities include sessile stony corals (Order Scleractinia), soft corals (Sub Class Octocorallia), black corals (Order Antipatharia), and lace corals (Freiwald et al. 2004, Hain and Corcoran 2004, Roberts and Hirshfield 2004). In complete darkness, deep-sea corals lack the symbiotic zooxanthellae found in their tropical counterparts and survive solely on suspension feeding. In the deep sea, Scleractinia and hydrocorals can build very large three-dimensional structures, "cold-water coral reefs," comparable in size and complexity with shallow water coral reefs (Hain and Corcoran 2004). Deep-sea coral communities are typically found from the edge of the continental shelf to the continental rise, on banks, and on seamounts (Freiwald et al. 2004). The distribution of known distribution of deep-sea corals in the Offshore Area of the Study Area is shown in Figure 3.8-2.

3.8.2.6.3.2 Inland Waters

Inshore area islet (small island) habitats support an abundant biota, including many species of cnidarians, comparable to the benthic communities found on fringing and barrier reefs (Maragos 1998). Inshore islets occur almost continuously along the Pacific Northwest coastline except at the mouths of large bays and estuaries (e.g., Columbia River mouth). Human impact in these regions tends to be minor, allowing islets to provide sheltered habitat for coral communities.

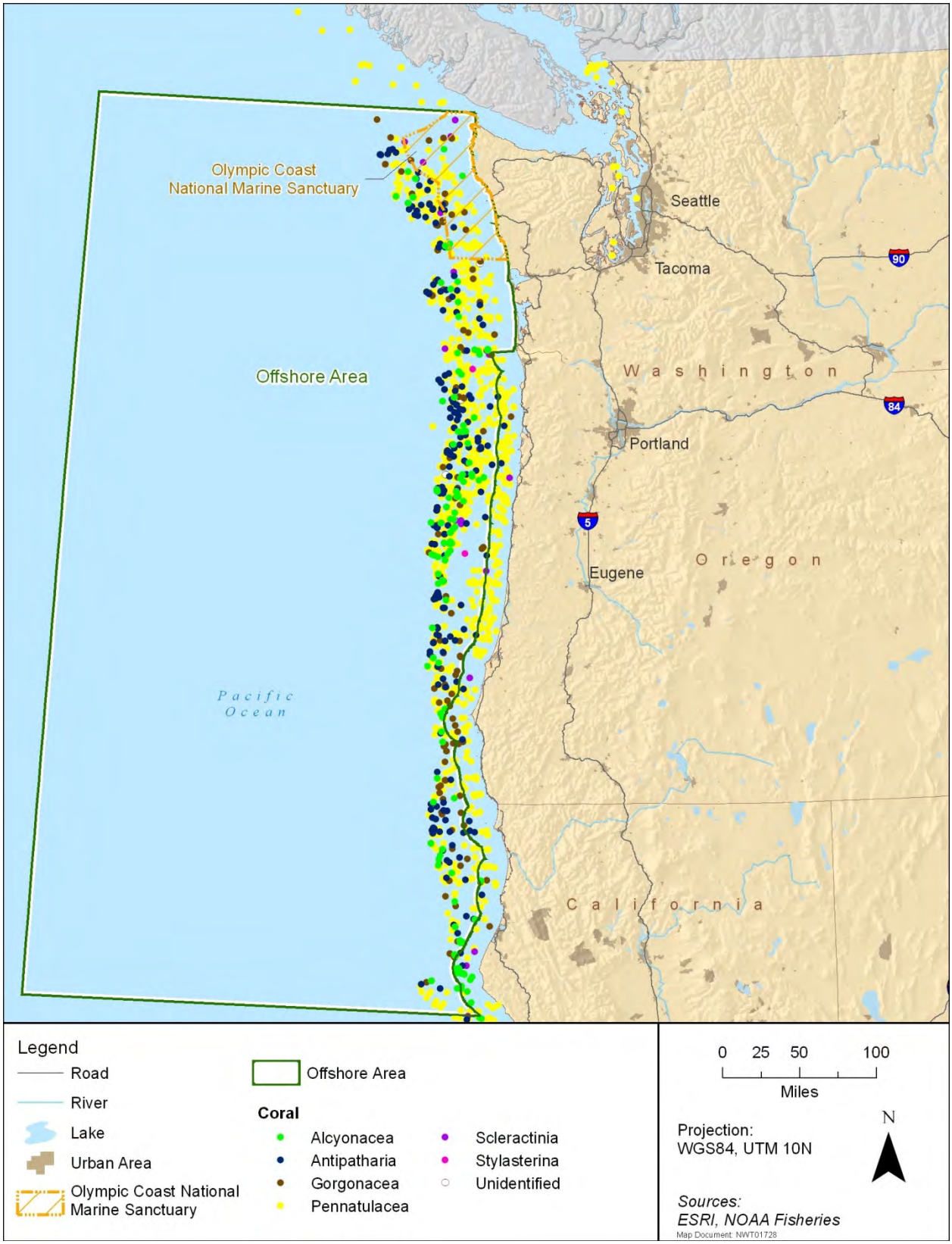

Figure 3.8-2: Deep-sea Corals in the Northwest Training and Testing Study Area

Habitat-forming deep-sea corals occur in the Puget Sound, as well as on the continental shelf of the Offshore Area. While the mean depth range of deep-sea corals in the Northeast Pacific Ocean is 265 to 1,262 m (869.4 to 4,140.4 ft.), deep-sea corals of the Study Area occur in water depths ranging from 9 to 3,450 m (29.5 to 11,318.9 ft.) (Etnoyer and Morgan 2003). Stylasteriidae corals are found in Puget Sound and Georgia Strait and on the shelf and shelf slope in waters shallower than 823 m (2,700.1 ft.) (Etnoyer and Morgan 2003). Jellyfish (cnidarians), comb jellyfish (ctenophorans), and hydroids are also found in the inland water area, throughout the water column, and on the water surface.

3.8.2.6.3.3 Western Behm Canal, Alaska

Many species of jellyfish occur in the Western Behm Canal as zooplankton, and the red-eye jellyfish (*Polyorchis penicellata*) is also present as an adult (Cowles 2006). Deep-sea coral ecosystems are also widespread throughout most of Alaska's marine waters, though knowledge of the distribution and abundance of deep-sea corals in Alaska is lacking. Therefore, deep sea coral may be found in the Western Behm Canal; however, the exact distribution and abundance of species is currently unknown (AKCSI 2012).

3.8.2.6.4 Flatworms (Phylum Platyhelminthes)

Flatworms include between 8,000 and 20,000 marine species worldwide (Appeltans et al. 2010; Castro and Huber 2000), and are the simplest form of marine worm (Castro and Huber 2000). The largest single group of flatworms is parasites commonly found in fishes, seabirds, and marine mammals (Castro and Huber 2000; University of California Berkeley 2010b). The life history of parasitic flatworms plays a role in the regulation of populations for the marine vertebrates they inhabit. Ingestion by the host organism is the primary dispersal method for parasitic flatworms. As parasites, they are not typically found in the water column, outside of a host organism. The remaining groups are non-parasitic carnivores, living without a host.

Flatworms occur in the Offshore Area, Inland Waters, and the Western Behm Canal, Alaska, portions of the Study Area as parasites in various fishes, seabirds, and whales that occur throughout the area. Free-living flat worms are not typically found in the water column, outside of a host organism (Castro and Huber 2000; University of California Berkeley 2010b).

3.8.2.6.5 Ribbon Worms (Phylum Nemertea)

Ribbon worms include approximately 1,000 marine species worldwide (Appeltans et al. 2010). Ribbon worms, with their distinct gut and mouth parts, are more complex than flatworms (Castro and Huber 2000). Organisms in this phylum are bottom-dwelling, predatory marine worms that are equipped with a long extension from the mouth (proboscis) that helps them capture food (Castro and Huber 2000). Some species are also equipped with a sharp needle-like structure that delivers poison to kill prey. Ribbon worms occupy an important place in the marine food web as prey for a variety of fish and invertebrates and as a predator of other bottom-dwelling organisms, such as worms and crustaceans (Castro and Huber 2000). Some ribbon worms are epiphytic and occupy the inside of the mantle of mollusks, where they feed on the waste products of their host (Castro and Huber 2000).

Ribbon worms occur on the seafloor of the Offshore Area, the Inland Waters, and the Western Behm Canal portions of the Study Area. They are widely distributed, carnivorous, and can be parasitic, feeding on the waste products of their mollusk hosts (Castro and Huber 2000).

3.8.2.6.6 Round Worms (Phylum Nematoda)

Round worms include over 5,000 marine species, though this number may be a gross underestimate (Appeltans et al. 2010). Common genera include *Anisakis* and *Thynnascaris* (Castro and Huber 2000). Round worms are small and cylindrical, and are abundant in sediments and in host organisms as parasites (Castro and Huber 2000). Round worms are one of the most widespread marine invertebrates, with population densities of one million organisms per 11 square feet (ft.^{2}) (1 square meter [m^2]) of mud (Levinton 2009). This group has a variety of food preferences, including algae, small invertebrates, annelid worms, and organic material from sediment. Like free-living flatworms, parasitic nematodes provide important ecosystem services by regulating populations of other marine organisms by causing illness or mortality in less viable organisms.

Round worms occur in the Offshore Area, Inland Waters, and the Western Behm Canal, Alaska, portions of the Study Area. Nematodes are found in or on most types of organisms as parasites, or commensals. They inhabit organisms such as mollusks, fish, reptiles, birds, and mammals (Hodda 2000).

3.8.2.6.7 Segmented Worms (Phylum Annelida)

Segmented worms include approximately 12,000 marine species worldwide in the phylum Annelida, although most marine forms are in the class Polychaeta (Appeltans et al. 2010). Segmented worms are the most complex group of marine worms, with a well-developed respiratory and gastrointestinal system (Castro and Huber 2000). Different species of segmented worms may be highly mobile or burrow in the seafloor (Castro and Huber 2000). Most segmented worms are predators; others are scavengers, deposit feeders, filter feeders, or suspension feeders of sand, sediment, and water (Hoover 1998c). The variety of feeding strategies and close connection to the seafloor make Annelids an integral part of the marine food web (Levinton 2009). Burrowing in the seafloor and agitating the sediment increases the oxygen content of the seafloor and makes important buried nutrients available to other organisms. This ecosystem service allows bacteria and other organisms, which are also an important part of the food web, to flourish on the seafloor.

3.8.2.6.7.1 Offshore Area

Areas that contain chemosynthetic communities (communities that obtain energy from chemical oxidation of simple inorganic compounds) in the Offshore Area of the Study Area generally also contain tubeworms (Kojima 2002). The benthic communities of the Oregon subduction zone are characterized by colonies of tube worms (phylum Pogonophora, *Lamellibrachia barhami*) along the crest of the marginal ridge (Kulm et al. 1986).

3.8.2.6.7.2 Inland Waters

In the Inland Waters portion of the Study Area, well-developed mudflat sediments are anaerobic, stable, and harbor substantial amounts of organic matter and microorganisms. Polychaete worms dominate the benthos where these mudflat sediments occur (Proctor et al. 1980).

3.8.2.6.7.3 Western Behm Canal, Alaska

In the Western Behm Canal, Alaska area, polychaete worms dominate the benthos where the canal harbors substantial amounts of organic matter and microorganisms (Proctor et al. 1980). These worms are essential to the diet of many Alaskan fish (National Marine Fisheries Service 2012).

3.8.2.6.8 Bryozoans (Phylum Bryozoa)

Bryozoans are small box-like, colony-forming animals that make up "lace corals." Classified in the Phylum Bryozoa, there are approximately 5,000 marine species worldwide (Appeltans et al. 2010). Bryozoans attach to a variety of surfaces, including rocks, shells, wood, artificial substrates, and algae, and feed on particles suspended in the water (Hoover 1998a). Bryozoans are found throughout the Study Area. Bryozoans are of economic importance for bioprospecting (the search for organisms for potential commercial use in pharmaceuticals). As common biofouling organisms, bryozoans also interfere with boat operations and clog industrial water intakes and conduits (Hoover 1998a).

3.8.2.6.8.1 Offshore Area

The Offshore Area includes the continental slope, and undersea mountains, which are habitats for deep-sea coral communities that contain bryozoans (U.S. Department of the Navy 2010). Many different species of bryozoans (such as *Stomatopora granulate*, *Proboscina incrassata*, *Diaperoecia californica*, *Diaperoecia intermedia*, *Tubulipora flabellaris*, *Discocytis canadensis*, and many more) are found in the Pacific Northwest and are widely distributed throughout the Offshore Area and in deep-sea coral communities.

3.8.2.6.8.2 Inland Waters

Two species of bryozoans (*Bugula pacifica* and *Tricellaria occidentalis*) from the northern Puget Sound have been shown to contain antibacterial compounds. The presence of antibacterial compounds may allow bryozoans to manipulate the microbial film growing on them, and may influence the types of organisms that are able to live near or on them. The ability to manipulate microbial films may also allow bryozoans to make the habitat nearby more suitable for the settlement of their own offspring (Shellenberger and Ross 1998). Bryozoans also make up a portion of deep-sea coral communities, which are found in a few locations in the Puget Sound and Inland Waters portion of the Study Area (U.S. Department of the Navy 2010).

3.8.2.6.8.3 Western Behm Canal, Alaska

The bryozoans common to the Western Behm Canal are leafy bryozoans (*Carbasea serrulata, Flustra serrulata*), crusty bryozoans (*Escharopsis lobata, Escharopsis sarsi*), and ribbed bryozoan (*Rhamphostomella costata*). Common substrates for bryozoan attachment in the Western Behm Canal include rocks and live or dead bivalve, gastropod, and crab shells (AFSC 2012).

3.8.2.6.9 Squid, Bivalves, Sea Snails, Chitons (Phylum Molluska)

Approximately 27,000 marine species are classified in the Phylum Molluska worldwide (Appeltans et al. 2010). Octopus and squid (cephalopods), sea snails and slugs (gastropods), clams and mussels (bivalves), and chitons (polyplacophorans) are mollusks with a muscular organ called a foot, which is used for mobility (Castro and Huber 2000). Sea snails and slugs eat fleshy algae and a variety of invertebrates, including hydroids, sponges, sea urchins, worms, and small crustaceans, as well as detritus (Castro and Huber 2000; Colin and Arneson 1995c). Clams, mussels, and other bivalves feed on plankton and other suspended food particles (Castro and Huber 2000). Chitons use rasping tongues, known as radula, to scrape food (algae) off rocks (Castro and Huber 2000; Colin and Arneson 1995c). Squid and octopus are active swimmers at all depths, and use a beak to prey on a variety of organisms, including fish, shrimp, and other squids (Castro and Huber 2000; Hoover 1998c). Octopuses mostly prey on fish, shrimp, eels, and crabs (Wood and Day 2005).

3.8.2.6.9.1 Offshore Area

In the Offshore Area, chemosynthetic communities are made of organisms that derive their energy from the conversion of carbon molecules and nutrients into organic matter. These organisms use the oxidation of inorganic molecules, or methane, as a source of energy (instead of using sunlight, as is the case with organisms that undergo photosynthesis). In the Pacific Northwest OPAREA giant white clams and mussels live in these chemosynthetic communities (Kojima 2002). The vesicomyid clam, *Calyptogena kilmeri*, is most common in areas characterized by high sulfide concentrations. In contrast, at the edge of seeps where sulfide levels are lower, *C. pacifica* is abundant. In cold seeps rich in methane such as brine pools or methane hydrates, mussels (*Bathymodiolus* spp.) are the dominant macrofauna. These mussels have a methane-based symbiosis where intracellular bacteria oxidize the methane and provide energy for the mussels and the bacteria (Nybakken 2001). Various species are attracted to the biological activity around cold seeps (Airamé et al. 2003). The benthic communities of the Oregon subduction zone contain giant clams (*Calyptogena* spp.) along the crest of the marginal ridge (Kulm et al. 1986). Humboldt squid (*Dosidicus gigas*) have been found off the coast of California, central Oregon, and Washington. The highest observed densities were in 2009 and measured 1,671 squid $(10^6 m^3)^{-1}$ (Litz et al. 2011). Various other species of squid and octopus inhabit the Offshore Area, including the giant Pacific octopus (*Enteroctopus dofleini*) (Flory 2007).

3.8.2.6.9.2 Inland Waters

The characteristic fauna of an Inland Waters portion of the Study Area sand flat includes cockle (*Clinocardium nuttalli*), white-sand clam (*Macoma secta*), and bent-nosed clam (*M. nasuta*) (Proctor et al. 1980). In unprotected rocky intertidal zones, mussels (*Mytilis* spp.) and barnacles form a biotic substrate that provides the necessary habitat for many other species.

Pacific oysters are widely cultivated in Dabob Bay, which is one of only three bays on the west coast where successful spawning of Pacific oysters occurs. Geoduck clams are the basis of an important commercial fishery in Puget Sound and are found in lower intertidal to subtidal soft bottom habitats; they can be found in waters as deep as 360.9 ft. (110 m) but are most abundant from 29.5 to 59.1 ft. (9 to 18 m) below mean low water level (U.S. Department of the Navy 2002).

In Puget Sound, hard substrate provides a substrate for the Olympia oyster (*Ostreola conchaphila*). The Olympia oyster is the only oyster native to the Pacific Northwest. Historically Olympia oyster beds existed throughout most of southern Puget Sound and specifically Willapa and Samish Bays. By 1960, overharvesting and pollution had nearly exterminated most of south Puget Sound's once-thriving Olympia oyster populations. In 1998, the Washington Department of Fish and Wildlife developed the Olympia Oyster Stock Rebuilding Plan. Subsequently, Olympia oysters have survived in north and central Puget Sound, and populations in the south Sound and Hood Canal are gradually recovering (Peter-Contesse and Peabody 2005).

Within Washington State, Pacific razor clam (*Siliqua patula*), geoduck, Manila clam (*Veneruplis philippinarum*), and Pacific oyster (*Crassostrea gigas*) occur and are harvested as a commercial fishery.

Humboldt squid have also been found in Puget Sound (Litz et al. 2011). Various other species of squid and octopus inhabit the Inland Waters, including the giant Pacific octopus (Flory 2007).

3.8.2.6.9.3 Western Behm Canal, Alaska

The Pacific razor clam occurs from western Alaska to Pismo Beach, California, on flat or gently sloping sandy beaches with heavy to moderate surf (Moore 2001). Squid and other mollusks could occur in the Western Behm Canal, Alaska; however, they are not densely distributed in the area.

3.8.2.6.10 Shrimp, Crab, Barnacles, Copepods (Phylum Arthropoda)

Shrimp, crab, barnacles, and copepods are animals with skeletons on the outside of their body (Castro and Huber 2000). Classified in the Phylum Arthropoda, over 50,000 species belong to the subphylum Crustacea within Phylum Arthropoda (Appeltans et al. 2010). Shrimp and crabs are typically carnivorous or omnivorous predators or scavengers, preying on mollusks (primarily gastropods, such as limpets, sea snails and slugs), other crustaceans, echinoderms (such as starfish, urchins, and sea cucumbers), small fish, algae, and sea grass (Waikiki Aquarium 2009a, b, c; Western Pacific Regional Fishery Management Council 2009). Barnacles and copepods feed by filtering algae and small organisms from the water (Levinton 2009).

3.8.2.6.10.1 Offshore Area

Juvenile crabs (megalopae), and copepods tend to seasonally dominate the near-surface zooplankton community in the Offshore Area of the Study Area(Peterson 1997; Reese et al. 2005; Swartzman et al. 2005). The distribution of zooplankton along the coastline of the Offshore Area of the Study Area can be described as “patchy,” with localized regions of high zooplankton concentrations spanning a distance from the coastline out to 93 mi. (150 km) offshore (Swartzman and Hickey 2003; Ressler et al. 2005; Swartzman et al. 2005); highest zooplankton abundances are found within the upper 65 ft. (20 m) of the water column over the inner-and mid-shelf (Peterson and Miller 1975, 1977). Adult Dungeness crabs can be found in waters as deep as 300 ft. (91 m) and on substrates consisting of mud, rock, and gravel bottoms; however, they prefer soft substrates. The biological diversity of deep-sea coral communities is high, and includes crustaceans (crabs and lobsters) and mollusks (clams and snails). Deep-sea coral communities are found along the entire continental slope of the Offshore Area of the Study Area (Figure 3.8-2).

3.8.2.6.10.2 Inland Waters

In the inshore area, copepods form the largest fraction of the zooplankton biomass in the main basin of Puget Sound. Small copepods are numerically dominant, with the genus *Acartia* being the most abundant. Larger copepods make up the majority of the zooplankton biomass, specifically the genus *Calanus* (Strickland 1983). These copepods tend to feed on diatoms that dominate the spring bloom in the region. Adult Dungeness (crabs can be found in waters as deep as 295 ft. (90 m) and on substrates consisting of mud, rock, and gravel bottoms; however, they prefer soft substrates. Juvenile crabs are often found in the soft substrata of intertidal eelgrass beds.

3.8.2.6.10.3 Western Behm Canal, Alaska

In the Western Behm Canal copepods including *Pseudocalanus, Acartia,* and *Centropages,* are the dominate zooplankton. Common species of Anthropoda in the Western Behm Canal portion of the Study Area include dungeness crab, tanner crab (*Chionoecetes bairdi*), spot shrimp (*Pandalus platyceros*), and coonstripe shrimp (*Pandalus hypsinotus*). Dungeness crabs are found in estuarine, intertidal, and subtidal zones. Tanner crabs inhabit deeper water than the Dungeness crab. The Tanner crab is rare in water less than 328 ft. (100 m) deep and common in depths of over 492 ft. (150 m). Spot shrimp and coonstripe shrimp are found in high concentrations along the sides of fjord basins. Other less-abundant

shrimp in the Western Behm Canal portion of the Study Area include sidestripe shrimp (*Pandalopsis dispar*) and pind shrimp (*Pandalus borealis*).

3.8.2.6.11 Sea Stars, Sea Urchins, Sea Cucumbers (Phylum Echinodermata)

Phylum Echinodermata has over 6,000 marine species, such as sea stars, sea urchins, and sea cucumbers (Appeltans et al. 2010). Sea stars (asteroids), sea urchins (echinoids), sea cucumbers (holothuriods), brittle stars and basket stars (ophuiroids), and feather stars and sea lilies (crinoids) are symmetrical around the center axis of the body (Castro and Huber 2000). Most echinoderms have separate sexes, but unisexual forms occur among the sea stars, sea cucumbers, and brittle stars. Many species have external fertilization, producing planktonic larvae, but some brood their eggs, never releasing free-swimming larvae (Colin and Arneson 1995b). Many echinoderms are either scavengers or predators on organisms that do not move, such as stony corals, sponges, clams, and oysters (Hoover 1998b). Some species filter food particles from sand, mud, or water.

3.8.2.6.11.1 Offshore Area

In the Offshore Area, invertebrates are found on seamounts and include brittlestars (ophiuroids), sea lilies (crinoids), seastars, tunicates, sea urchins, and sea cucumbers (Wilson and Kaufmann 1987, Rogers 1994). In many areas of the deep sea, brittlestars are the dominant macrofauna; they are often found around sea pen (*Pennatulacea*) beds and are so abundant that their feeding behavior and high activity levels can alter the ecology of benthic soft-bottom communities. Habitat-forming deep-sea coral communities are commonly found between 875 and 4,200 ft. deep (265 and 1,260 m), but may be found as deep as 11,400 ft. (3,450 m) (Etnoyer and Morgan 2003) and include echinoderms (starfish, sea urchins, brittle stars, and feather stars) (U.S. Department of the Navy 2010).

3.8.2.6.11.2 Inland Waters

Rocky intertidal habitats occur throughout the Inland Waters portion of the Study Area, and are where various sea anemones, sea stars, and brittle stars are very prominent (Proctor et al. 1980). Predacious sea stars (*Pisaster ochraceous*) are characteristic of unprotected rocky intertidal regions (Proctor et al. 1980). These sea stars can be found up to depths of 295 ft. (90 m) and are very resilient to environmental changes, such as temperature change, wave action, and decreased water availability (Grzimeck 1972).

3.8.2.6.11.3 Western Behm Canal, Alaska

Sea anemones, sea stars, brittle stars, red urchins, and other echinoderms occur in rocky intertidal habitats throughout the Western Behm Canal. The abundance of sea cucumbers in Southeast Alaska is greatest in the southern and western portions in protected bays and inlets.

Red sea cucumbers (*Parastichopus californicus*) exist in habitat types ranging from shell debris, gravel, mud, silt, and boulders. A study conducted in Southeast Alaska showed that the most common habitat for sea cucumbers was shell debris and gravel. They occupy a broad range of subtidal habitats from nearshore shallows to over 100 fathoms. In the Western Behm Canal portion of the Study Area, the red sea urchin (*Strongylocentrotus franciscanus*) occurs primarily on rocky shorelines of the outside coast with largest concentrations in southeast. They can inhabit intertidal depth to up to 295.3 ft. (90 m) (Alaska Department of Fish and Game 2012).

3.8.3 ENVIRONMENTAL CONSEQUENCES

This section analyzes the potential impacts on marine invertebrates from implementing the project alternatives, including the No Action Alternative, Alternative 1, and Alternative 2. United States Department of the Navy (Navy) training and testing activities are evaluated for their potential impact on marine invertebrates in general, by taxonomic groups, species proposed for listing, and federally managed species or groups (see Section 3.8.2, Affected Environment).

General characteristics of all Navy stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis) and living resources' general susceptibilities to stressors are discussed in Appendix H (Biological Resource Methods). Stressors vary in intensity, frequency, duration, and location within the Study Area (Table 3.8-2).

Table 3.8-2: Stressors for Marine Invertebrates in the Northwest Training and Testing Study Area

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Acoustic Stressors							
Sonar and other active acoustic sources (hours)	Offshore Area	362	24	551	977	551	1,073
	Inland Waters	0	2,354	407	5,448	407	5,939
	W. Behm Canal	0	0	0	2,762	0	3,838
Sonar and other active acoustic sources (items)	Offshore Area	880	364	916	943	916	1,024
	Inland Waters	0	308	0	1,308	0	1,410
	W. Behm Canal	0	0	0	0	0	0
Underwater Explosives	Offshore Area	378	0	502	148	502	164
	Inland Waters	4	0	42	0	42	0
	W. Behm Canal	0	0	0	0	0	0
Weapons firing, launch, and impact noise	Offshore Area	QUALITATIVE					
	Inland Waters						
	W. Behm Canal						
Activities including vessel noise	Offshore Area	996	37	1,088	138	1,088	162
	Inland Waters	4	337	28	582	28	640
	W. Behm Canal	0	28	0	60	0	83
Activities including aircraft noise	Offshore Area	3,826	2	6,471	74	6,471	84
	Inland Waters	124	2	127	20	127	25
	W. Behm Canal	0	0	0	0	0	0
Energy Stressors							
Activities including electromagnetic devices	Offshore Area	0	0	0	0	0	0
	Inland Waters	0	0	1	0	1	0
	W. Behm Canal	0	0	0	0	0	0

Table 3.8-2: Stressors for Marine Invertebrates in the Northwest Training and Testing Study Area (continued)

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Physical Disturbance and Strike Stressors							
Activities including vessel movement	Offshore Area	996	37	1,096	138	1,096	162
	Inland Waters	4	337	28	582	28	640
	W. Behm Canal	0	28	0	60	0	83
Activities including in-water devices	Offshore Area	429	40	484	154	484	183
	Inland Waters	0	379	1	648	1	716
	W. Behm Canal	0	0	0	0	0	0
Military expended materials	Offshore Area	189,668	621	196,888	2,511	196,888	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Activities including seafloor devices	Offshore Area	0	5	0	6	0	7
	Inland Waters	2	210	16	225	16	239
	W. Behm Canal	0	0	0	5	0	15
Entanglement Stressors							
Fiber optic cables and guidance wires	Offshore Area	2	16	0	20	0	24
	Inland Waters	0	105	1	122	1	133
	W. Behm Canal	0	0	0	0	0	0
Parachutes	Offshore Area	8,382	17	8,382	1,229	8,382	1,351
	Inland Waters	0	4	0	4	0	5
	W. Behm Canal	0	0	0	0	0	0
Ingestions Stressors							
Military expended materials from munitions	Offshore Area	177,778	200	182,804	1,946	182,804	2,139
	Inland Waters	4	6	42	6	42	6
	W. Behm Canal	0	0	0	0	0	0
Military expended materials other than munitions	Offshore Area	11,890	421	9,084	565	9,084	625
	Inland Waters	4	440	43	511	43	562
	W. Behm Canal	0	0	0	0	0	0
Secondary Stressors							
Habitat (sediments and water quality; air quality)	Offshore Area	QUALITATIVE					
	Inland Waters						
	W. Behm Canal						

Based on the general threats to marine invertebrates discussed in Section 3.8.2 (Affected Environment), stressors applicable to marine invertebrates in the Study Area and analyzed below include the following:

- Acoustic (sonar and other active acoustic sources, underwater explosives)
- Energy (electromagnetic devices)

- Physical disturbance and strike (vessels and in-water devices, strikes, military expended materials, and seafloor devices)
- Entanglement (fiber optic cables and guidance wires, parachutes)
- Ingestion (munitions and military expended materials other than munitions)
- Secondary stressors (metals and chemicals)

These components are analyzed for potential impacts on marine invertebrates within the stressor categories contained in this section. The specific analyses of the training and testing activities consider these components, within the context of geographic location and overlap of marine invertebrate resources. Training activities are not proposed in the Western Behm Canal; therefore, only the Offshore Area and the Inland Waters will be analyzed under Training Activities. In addition to the analysis here, the details of all training and testing activities, stressors, and geographic occurrence within the Study Area are summarized in Section 3.0.5 3 (Identification of Stressors for Analysis) and detailed in Appendix A (Navy Activities Descriptions).

3.8.3.1 Acoustic Stressors

Assessing whether sounds may disturb or injure an animal involves understanding the characteristics of the acoustic sources, the animals that may be near the sound, and the effects that sound may have on the physiology and behavior of those animals. The methods used to predict acoustic effects on invertebrates build upon the Conceptual Framework for Assessing Effects from Sound-Producing Activities (Appendix H, Section H.1). Categories of potential impacts are direct trauma, hearing loss, auditory masking, behavioral reactions, and physiological stress. Little information is available on the potential impacts on marine invertebrates of exposure to sonar, explosions, and other sound-producing activities. Most studies focused on squid or crustaceans, and the consequences of exposures to broadband impulse air guns typically used for seismic exploration, rather than on sonar or explosions.

Direct trauma and mortality may occur due to the rapid pressure changes associated with an explosion. Most marine invertebrates lack air cavities that could make them vulnerable to trauma due to rapid pressure changes. Marine invertebrates could also be displaced by a shock wave, which could cause injury.

To experience hearing impacts, masking, behavioral reactions, or physiological stress, a marine invertebrate must be able to sense sound. Marine invertebrates are likely only sensitive to water particle motion caused by nearby low-frequency sources, and likely do not sense distant or mid- and high-frequency sounds (see Section 3.8.2.2, Invertebrate Hearing and Vocalization). Andre et al. (2011) found progressive damage to statocyst hair cells in squid after exposure to 2 hours of 50- to 100-Hz sweeps at sound pressure levels of 157–175 dB re 1 µPa; however, it is impossible to determine whether damage was because of the sound exposure or some other aspect of capture or captivity because inappropriate and incorrect controls were used. This limited information suggests that marine invertebrate statocysts may be resistant to impulse sound impacts, but that the impact of long-term or non-impulse sound exposures is undetermined.

Masking occurs when a sound interferes with an animal's ability to detect other biologically relevant sounds in its environment. Little is known about how marine invertebrates use sound in their environment. Some studies have shown that crab and coral larvae and post-larvae may use nearby reef sounds when in their settlement phase (Jeffs et al. 2003; Radford et al. 2007; Stanley et al. 2010; Vermeij et al. 2010), although it is unknown what component of reef noise is used. Larvae likely sense particle motion of nearby sounds, limiting their reef noise detection range (less than 328 ft. [100 m])

(Vermeij et al. 2010). Anthropogenic sounds could mask important acoustic cues, affecting detection of settlement cues or predators, potentially affecting larval settlement patterns or survivability in highly modified acoustic environments (Simpson et al. 2011). Low-frequency sounds could interfere with perception of low-frequency rasps or rumbles among crustaceans, although these are often already obscured by ambient noise (Patek et al. 2009).

Studies of invertebrate behavioral responses to sound have focused on responses to impulse sound. Some captive squid showed strong startle responses, including inking, when exposed to the first shot of broadband sound from a nearby seismic airgun (sound exposure level of 163 dB re 1 μPa^2-s), but strong startle responses were not seen when sounds were gradually increased (McCauley et al. 2000a, b). Slight increases in behavioral responses, such as jetting away or changes in swim speed, were observed at receive levels exceeding 145 dB re 1 μPa^2-s (McCauley et al. 2000a, b). Other studies have shown no observable response by marine invertebrates to sounds. Snow crabs did not react to repeated firings of a seismic airgun (peak received sound level was 201 dB re 1 µPa) (Christian et al. 2003), while squid did not respond to killer whale echolocation clicks (higher frequency signals ranging from 199 to 226 dB re 1 µPa) (Wilson et al. 2007). Krill did not respond to a research vessel approaching at 2.7 knots (source level below 150 dB re 1 µPa) (Brierley et al. 2003). Distraction may be a consequence of some sound exposures. Hermit crabs were shown to delay reaction to an approaching visual threat when exposed to continuous noise, putting them at increased risk of predation (Chan et al. 2010).

There is some evidence of possible stress effects on invertebrates from long-term or intense sound exposure. Captive sand shrimp exposed to low-frequency noise (30 to 40 dB above ambient) continuously for three months demonstrated decreases in both growth rate and reproductive rate (Lagardère 1982). Sand shrimp showed lower rates of metabolism when kept in quiet, soundproofed tanks than when kept in tanks with typical ambient noise (Lagardère and Régnault 1980). Repeated intense airgun exposures caused no changes in biochemical stress markers in snow crabs (Christian et al. 2003), but some biochemical stress markers were observed in cephalopods (Andre et al. 2011). The study found the first morphological evidence of massive acoustic trauma, in four cephalopod species subjected to low-frequency controlled-exposure experiments. Exposure to low-frequency sounds resulted in permanent and substantial alterations of the sensory hair cells of the statocysts, the structures responsible for the cephalopod's sense of balance and position. These results indicate a need for further environmental regulation of human activities that introduce high-intensity, low-frequency sounds in the ocean, and the need for future research (Andre et al. 2011). No correlation was found between catch rate and seismic airgun activity, implying no long-term population impacts from intermittent anthropogenic sound exposure over long periods.

Because research on the consequences of marine invertebrate exposures to anthropogenic sounds is limited, qualitative analyses were conducted to determine the effects of the following acoustic stressors on marine invertebrates within the Study Area: non-impulse sources (including sonar, vessel noise, aircraft overflights, and other active acoustic sources) and impulse acoustic sources (including explosives and weapons firing).

3.8.3.1.1 Impacts from Sonar and Other Active Acoustic Sources

Sources of sonar and other active acoustic sources during training and testing events include broadband vessel noise (including surface ships, boats, and submarines), aircraft overflight noise (fixed-wing and rotary-wing aircraft), sonar, and other active non-impulse sources. Non-impulse sounds associated with training and testing are described in Section 3.0.5.3.1 (Acoustic Stressors).

Surface combatant ships and submarines are designed to be quiet to evade enemy detection, whereas other Navy ships and small craft have higher source levels, similar to equivalently sized commercial ships and private vessels (see Section 3.0.5.3.1.4, Vessel Noise). Ship noise tends to be low-frequency and broadband. Received noise levels from aircraft would depend on the platform, speed, and altitude (see Section 3.0.5.3.1.5, Aircraft Overflight Noise). Aircraft noise transmitted into water is strongest just below the surface and directly under the aircraft. Sonar and other active acoustic sound sources emit sound waves into the water to detect objects, safely navigate, and communicate. These sources may emit low-, mid-, high-, or very-high-frequency sounds at various sound pressure levels.

Most marine invertebrates do not have the capability to sense sound; however, some may be sensitive to nearby low-frequency and possibly lower-mid-frequency sounds, such as some active acoustic sources or vessel noise (see Section 3.8.2.2, Invertebrate Hearing and Vocalization). Because marine invertebrates lack the adaptations that would allow them to sense sound pressure levels at long distances, the distance at which they may detect a sound is limited.

The relatively low sound pressure level beneath the water surface due to aircraft is likely not detectable by most marine invertebrates. For example, the sound pressure level from an H-60 helicopter hovering at 50 ft. (15.3 m) is estimated to be about 125 dB re 1 µPa at 1 m below the surface, a sound pressure lower than other sounds to which marine invertebrates have shown no reaction (see Section 3.8.3.1, Acoustic Stressors [sonar and other active acoustic sources, underwater explosives]). Therefore, impacts due to aircraft overflight noise are not expected.

There are no training activities proposed in the Western Behm Canal portion of the Study Area under the No Action Alternative, Alternative 1, or Alternative 2. Therefore, non-impulse sound would have no impact on marine invertebrates under the No Action Alternative, Alternative 1, or Alternative 2.

3.8.3.1.1.1 No Action Alternative

Training Activities

Offshore Area

The locations and number of activities proposed for training and testing under the No Action Alternative are shown in Tables 2.8-1 through 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Training activities producing sound which might affect marine invertebrates are described. Sounds produced during training are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), Section 3.0.5.3.1.4 (Vessel Noise), and Section 3.0.5.3.1.5 (Aircraft Overflight Noise).

Under the No Action Alternative, training activities using sonar and other active acoustic sources would occur throughout the Offshore Area of the Study Area. Training activities in the Offshore Area would result in approximately 362 hours of in-water noise from the use of sonar and other active acoustic sources. In addition to the 362 hours, 880 items that produce in-water acoustic noise would be used. The location and number of activities proposed for these training activities are shown in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Navy vessel noise associated with training would occur throughout the Offshore Area of the Study Area with 996 vessel movements (see Table 3.0-18).

As discussed above, most marine invertebrates would not sense mid- or high-frequency sounds, distant sounds, or aircraft noise transmitted through the air-water interface (see Section 3.8.2.2, Invertebrate Hearing and Vocalization). Most marine invertebrates would not be close enough to intense sound sources, such as non-impulse sonar, to potentially experience impacts to sensory structures. Any marine

invertebrate capable of sensing sound may alter its behavior (e.g., change swim speed) if exposed to non-impulse sound, although it is unknown if responses to non-impulse sounds occur. Continuous noise, like that produced by vessels, may contribute to masking of relevant environmental sounds, such as reef noise. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would be brief. Without prolonged proximate exposures, population level impacts are not expected. Although non-impulse underwater sounds produced during training activities may momentarily distract individuals, intermittent exposures to non-impulse sounds are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

Inland Waters

The locations and number of activities proposed for training and testing under the No Action Alternative are shown in Tables 2.8-1 through 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during training are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), and Section 3.0.5.3.1.4 (Vessel Noise).

Under the No Action Alternative, training activities using other active acoustic sources would occur in the Inland Waters. The location and number of activities proposed for these training activities are shown in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Navy vessel noise associated with training would occur in the Inland Waters. Under the No Action Alternative, 4 activities would occur in the inland waters portion of the Study Area (see Table 3.8-2).

As discussed above, most marine invertebrates would not sense distant sounds, or aircraft noise transmitted through the air-water interface (see Section 3.8.2.2, Invertebrate Hearing and Vocalization). Most marine invertebrates would not be close enough to intense sound sources, to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior due to masking of relevant environmental sounds. Human-made noise may impact coral larvae by masking the natural sounds that serve as cues to orient them towards suitable settlement sites (Vermeij et al. 2010). However, if exposed to non-impulse sound, it is unknown if behavioral responses occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would last only minutes. Without prolonged proximate exposures, population-level impacts are not expected. Although non-impulse underwater sounds produced during training activities may briefly impact individuals, intermittent exposures to non-impulse sounds under the No Action Alternative are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

Testing Activities

Offshore Area

Under the No Action Alternative, testing activities using sonar and other active acoustic sources would occur in the Quinault Range Site surf zone portion of the Study Area (see Figure 2.1-2). Underwater noise from vessels associated with testing would occur throughout the Offshore Area of the Study Area while in transit. Under the No Action Alternative, testing activities using sonar and other active acoustic sources would occur throughout the Offshore Area of the Study Area. Testing activities in the Offshore Area would result in approximately 24 hours of in-water noise from the use of sonar and other active acoustic sources. In addition to the 24 hours, 364 items that produce in-water acoustic noise would be used. The location and number of activities proposed for these testing activities are shown in Tables 2.8-

2 and 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Navy vessel noise associated with testing would occur throughout the Offshore Area of the Study Area with 37 vessel movements (see Table 3.8-2). Even with testing activities occurring in a smaller area than training activities, the impacts to marine invertebrates would be the same as for training activities under the No Action Alternative.

Inland Waters

Under the No Action Alternative, testing activities using sonar and other active acoustic sources would occur throughout Inland Waters of the Study Area. Underwater noise from vessels and aircraft overflights associated with testing would occur in all the range complexes, the training ranges, and throughout the Inland Waters. Certain portions of the Inland Waters, such as areas near Navy ports, installations, and training and testing ranges are used more heavily by vessels and aircraft than other portions of the Study Area.

Testing activities in the Inland Waters would result in approximately 2,354 hours of in-water noise from the use of sonar and other active acoustic sources. In addition to the 2,354 hours, 308 items that produce in-water acoustic noise would be used. The location and number of activities proposed for these testing activities are shown in Tables 2.8-2 and 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Navy vessel noise associated with testing would occur in the Inland Waters. Under the No Action Alternative, 337 activities would occur in the inland waters portion of the Study Area (see Table 3.8-2).

As discussed above, most marine invertebrates would not sense mid- or high-frequency sounds, distant sounds, or aircraft noise transmitted through the air-water interface (see Section 3.8.2.2, Invertebrate Hearing and Vocalization). Most marine invertebrates would not be close enough to intense sound sources, such as some sonar, to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior due to masking of relevant environmental sounds and become disoriented if exposed to non-impulse sound, although it is unknown if responses to non-impulse sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds, such as reef noise. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would be brief. Without prolonged proximate exposures, population level impacts are not expected. Although non-impulse underwater sounds produced during testing activities may briefly impact individuals (disorient), intermittent exposures to non-impulse sounds under the No Action Alternative are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

Western Behm Canal, Alaska

Under the No Action Alternative, marine invertebrates would be exposed to vessel noise during testing activities for approximately 28 vessel movements (see Table 3.8-2). The locations and number of activities proposed for testing under the No Action Alternative are shown in Tables 2.8-2 and 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during testing are described in Section 3.0.5.3.1.4 (Vessel Noise).

Any marine invertebrate capable of sensing sound may alter its behavior if exposed to non-impulse sound, although it is unknown if responses to non-impulse sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds, such as reef noise. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels

would be in transit, any sound exposures with the potential to cause masking or behavioral responses would be brief. Without prolonged proximate exposures, population-level impacts are not expected. Although non-impulse underwater sounds produced during testing activities under the No Action Alternative may momentarily impact individuals, intermittent exposures to non-impulse sounds are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

3.8.3.1.1.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during training activities. Training activities in the Offshore Area would increase to approximately 551 hours of in-water noise from the use of sonar and other active acoustic sources, and 916 items that produce in-water acoustic noise would be used. The use of vessels would increase from 996 under the No Action Alternative to 1,096 under Alternative 1 in the Offshore portion of the Study Area (see Table 3.8-2)

In comparison to the No Action Alternative, the increased use acoustic sources associated with training under Alternative 1 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated above in No Action Alternative, non-impulse sounds associated with training under Alternative 1 are not expected to impact marine invertebrates or cause more than a momentary behavioral disturbance (such as disorientation) to those marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

Inland Waters

Under Alternative 1, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during training activities. Training activities in the Inland Waters would increase to approximately 407 hours of in-water noise from the use of sonar and other active acoustic sources. The use of vessels would increase from 4 activities under the No Action Alternative to 28 under Alternative 1 (see Table 3.8-2).

In comparison to the No Action Alternative, the increased use of sonar, vessels, and aircraft associated with training under Alternative 1 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would be similar to the No Action Alternative. However, due to the increased exposure, there may be the potential for additional impacts. For the same reasons as stated above in No Action Alternative, non-impulse sounds associated with training activities under Alternative 1 are not expected to impact the majority of marine invertebrates or cause more than a short-term behavioral disturbance (e.g., change in orientation or swim speeds) to some marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

Testing Activities

Offshore Area

Under Alternative 1, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during testing activities. Testing activities in the Offshore Area would increase to approximately 977 hours of in-water noise from the use of sonar and other active acoustic sources, and 943 items that produce in-water acoustic noise would be used. The use of vessels would increase, from 37 activities under the No Action Alternative to 138 under Alternative 1 (see Table 3.8-2).

In comparison to the No Action Alternative, the increased use of sonar, vessels, and aircraft associated with testing under Alternative 1 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. As discussed above, most marine invertebrates would not sense distant sounds or aircraft noise transmitted through the air-water interface (see Section 3.8.2.2, Invertebrate Hearing and Vocalization). Most marine invertebrates would not be close enough to intense sound sources to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior and become disoriented due to masking of relevant environmental sounds if exposed to non-impulse sound, although it is unknown if responses to non-impulse sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would last only minutes.

For the same reasons as stated above in No Action Alternative, non-impulse sounds associated with testing under Alternative 1 are not expected to impact the majority of marine invertebrates or cause more than a short-term behavioral disturbance (e.g., change in orientation or swim speeds) to those marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

Inland Waters

Under Alternative 1, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during testing activities. Testing activities in the Inland Waters would increase to approximately 5,448 hours of in-water noise from the use of sonar and other active acoustic sources, and 1,308 items that produce in-water acoustic noise would be used. The use of vessels would increase from 337 activities under the No Action Alternative to 582 under Alternative 1 (see Table 3.8-2).

In comparison to the No Action Alternative, the increased use of sonar, vessels, and aircraft associated with testing under Alternative 1 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would be similar to the No Action Alternative. Due to the increased exposure, there may be increased potential for additional impacts. For the same reasons as stated above in No Action Alternative, non-impulse sounds associated with testing activities under Alternative 1 are not expected to impact most marine invertebrates or cause more than a short-term behavioral disturbance(e.g., change in orientation or swim speeds to some marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

Western Behm Canal, Alaska

Under Alternative 1, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during testing activities. Testing activities in the Western Behm Canal would result in approximately 2,762 hours of in-water noise from the use of sonar and other active acoustic sources. The use of vessels would from 28 activities under the No Action Alternative to 60 under Alternative 1 (see Table 3.8-2).

Any marine invertebrate capable of sensing sound may alter its behavior if exposed to non-impulse sound, although it is unknown if responses to non-impulse sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds, such as reef noise. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit, any sound exposures with the potential to cause masking or behavioral responses would be brief. Without prolonged proximate exposures, population-level impacts are not expected. Although non-impulse underwater sounds produced during testing activities under the No Action Alternative may momentarily impact individuals, intermittent exposures to non-impulse sounds are not expected to impact survival, growth, recruitment, or reproduction of widespread marine invertebrate populations.

3.8.3.1.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during training activities. Training activities in the Offshore Area would increase to approximately 551 hours of in-water noise from the use of sonar and other active acoustic sources, and 916 items that produce in-water acoustic noise would be used. The use of vessels would remain 1,096, the same as under Alternative 1 (i.e., an increase from 996 under the No Action Alternative to 1,096 under Alternative 1 in the Offshore portion of the Study Area [see Table 3.8-2]).

In comparison to the No Action Alternative, the increased use of sonar, vessels, and aircraft associated with training under Alternative 2 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated above in the No Action Alternative, non-impulse sounds associated with training under Alternative 2 are not expected to impact the majority of marine invertebrates or cause more than a momentary disturbance to those marine invertebrates capable of detecting nearby sound. No population -level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 2.

Inland Waters

Under Alternative 2, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during training activities. Training activities in the Inland Waters would increase to approximately 407 hours of in-water noise from the use of sonar and other active acoustic sources. The use of vessels would remain 28, the same as under Alternative 1 (i.e., an increase from 4 activities under the No Action Alternative to 28 under Alternative 1 in the Inland Waters of the Study Area [see Table 3.8-2]).

Testing Activities

Offshore Area

Under Alternative 2, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during testing activities. Testing activities in the Offshore Area would increase to approximately 1,073 hours of in-water noise from the use of sonar and other active acoustic sources, and 1,024 items that produce in-water acoustic noise would be used. That is an increase from approximately 24 hours and 364 items under the No Action Alternative. The use of vessels would increase from 37 activities under the No Action Alternative to 162 under Alternative 1 (see Table 3.8-2).

In comparison to the No Action Alternative and Alternative 1, the increased use of sonar, vessels, and aircraft associated with testing under Alternative 2 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated in the No Action Alternative, non-impulse sounds associated with testing under Alternative 1 are not expected to impact the majority of marine invertebrates or cause more than a momentary behavioral disturbance (e.g., a change in swim speed) to those marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 2.

Inland Waters

Under Alternative 2, marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, vessel noise, and aircraft overflight noise during testing activities. Testing activities in the Inland Waters would increase to approximately 5,939 hours of in-water noise from the use of sonar and other active acoustic sources, and 1,410 items that produce in-water acoustic noise would be used. The use of vessels would increase from 337 activities under the No Action Alternative to 640 under Alternative 2 see(see Table 3.8-2).

In comparison to the No Action Alternative and Alternative 1, the increased use of sonar, vessels, and aircraft associated with testing under Alternative 2 would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain similar to Alternative 1. However, due to the increased exposure, there may be the potential for additional impacts. For the same reasons as stated above in Alternative 1, non-impulse sounds associated with testing under Alternative 2 are not expected to impact most marine invertebrates or cause more than a momentary behavioral disturbance (e.g., a change in swim speed) to some marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 2.

Western Behm Canal, Alaska

Under Alternative 2 marine invertebrates would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources, and vessel noise during testing activities. Testing activities in the Western Behm Canal would result in approximately 3,838 hours of in-water noise from the use of sonar and other active acoustic sources, an increase from 28 hours under the No Action Alternative. The use of vessels would increase 66 percent, from 28 activities under the No Action Alternative to 83 under Alternative 2 (see Table 3.8-2).

In comparison to Alternative 1, the increased use of vessels associated with testing under Alternative 2 in the Western Behm Canal portion of the Study Area would increase the likelihood of exposure of marine invertebrates to non-impulse underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated above in Alternative 1, non-impulse sounds associated with testing under Alternative 2 are not expected to impact most marine invertebrates or cause more than a momentary behavioral disturbance (e.g., change in swim speed) to some marine invertebrates capable of detecting nearby sound. No population-level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 2.

3.8.3.1.1.4 Substressor Impact on Sedentary Invertebrate Beds and Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other active acoustic sources during training and testing activities would have no adverse effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern within the Study Area.

3.8.3.1.2 Impacts from Underwater Explosives and Other Impulse Sources

Explosions, weapons firing, launch, and impact of ordnance on the water surface, as well as airguns, introduce loud, impulse, broadband sounds into the marine environment. Impulse sources are characterized by rapid pressure rise times and high peak pressures. Explosions produce high-pressure shock waves that could cause injury or physical disturbance due to rapid pressure changes. Some other impulse sources, such as airguns, also produce shock waves, but of lower intensity. Impulse sounds are usually brief, but the associated rapid pressure changes can injure or startle marine invertebrates.

Limited studies have examined mortality rates of crustaceans at various distances from detonations in shallow water (Aplin 1947; Chesapeake Biological Laboratory 1948; Gaspin et al. 1976). Similar studies of mollusks have shown them to be more resistant than crustaceans to explosive impacts (Chesapeake Biological Laboratory 1948; Gaspin et al. 1976). Other invertebrates found in association with mollusks, such as sea anemones, polychaete worms, isopods, and amphipods, were observed to be undamaged in areas near detonations (Gaspin et al. 1976). Using data from these experiments, Young (1991) developed curves that estimate the distance from an explosion beyond which at least 90 percent of certain marine invertebrates would survive, depending on the weight of the explosive (Figure 3.8-3).

In deeper waters where most detonations would occur near the water surface, most benthic marine invertebrates would be beyond the 90 percent survivability ranges shown above, even for larger quantities of explosives. In addition, most detonations would occur near the water surface, releasing a portion of the explosive energy into the air rather than the water and reducing impacts to marine invertebrates throughout the water column. The number of organisms affected would depend on the size of the explosive, the distance from the explosion, and the presence of groups of pelagic invertebrates. In addition to trauma caused by a shock wave, organisms could be killed in an area of cavitation that forms near the surface above large underwater detonations. Cavitation is where the reflected shock wave creates a region of negative pressure followed by a collapse, or water hammer (see Section 3.0.4, Introduction to Acoustics).

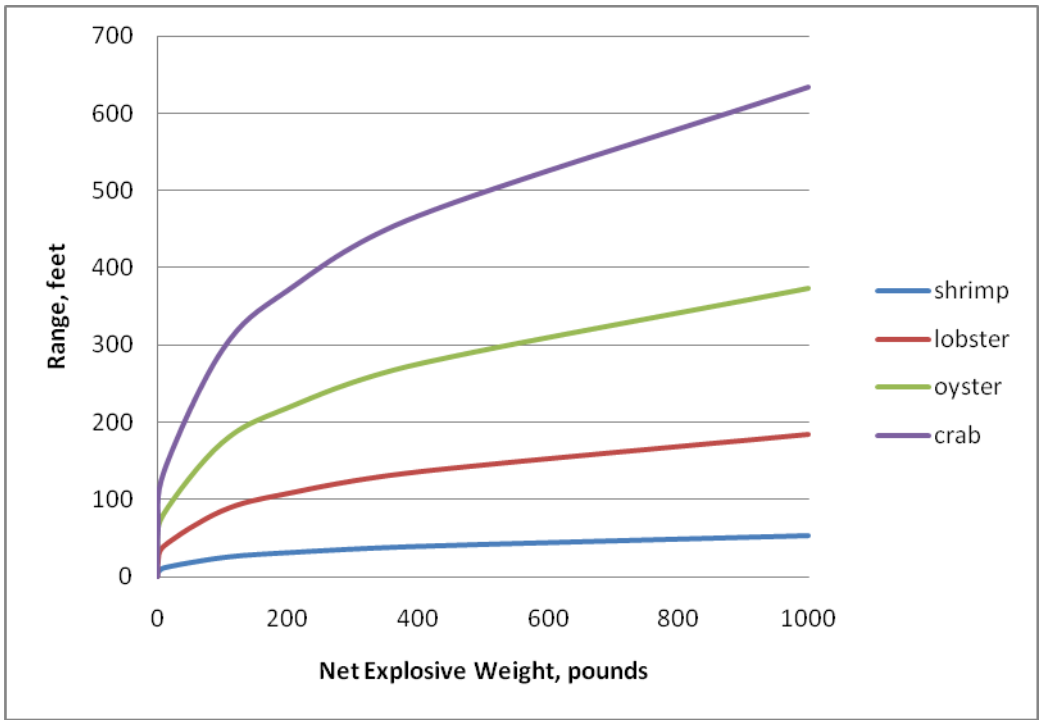

Figure 3.8-3: Prediction of Distance to 90 Percent Survivability of Marine Invertebrates Exposed to Underwater Explosions (Young 1991)

Some charges are detonated in shallow water or near the seafloor, including explosive ordnance demolition charges and some explosions associated with mine warfare. In addition to injuring nearby organisms, a blast near the bottom could potentially disturb hard substrate suitable for colonization (see Section 3.3.3.1, Acoustic Stressors). An explosion in the near vicinity of hard corals could cause fragmentation and siltation of the mollusk beds. Live hard bottom (such as shallow coral reefs and mollusk beds) are avoided during activities involving explosives and precision anchoring exercises (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring).

Firing weapons on a ship generates sound by firing the gun (muzzle blast), the shell flying through the air, and vibration from the blast propagating through the ship's hull (see Section 3.0.5.3.1.3, Weapons Firing, Launch, and Impact Noise). In addition, larger non-explosive munitions and targets could produce loud impulse noise when hitting the water, depending on the size, weight, and speed of the object at impact (McLennan 1997). Small- and medium-caliber munitions are not expected to produce substantial impact noise.

At a distance, impulses lose their high pressure peak and take on characteristics of non-impulse acoustic waves. Similar to the impacts expected for non-impulse sounds discussed previously, it is expected these exposures would cause no more than brief startle reactions in some marine invertebrates.

No underwater explosions or weapons firing would take place for any training or testing activity under any proposed alternative in the Western Behm Canal portion of the Study Area. Therefore, explosions or weapons firing would have no impact to marine invertebrates under any alternative.

3.8.3.1.2.1 No Action Alternative

Training Activities

The number of training events using explosives, weapons firing, launches, and non-explosive munitions and their proposed locations is presented in Tables 3.0-21 and 3.0-22. A discussion of explosives and the number of detonations in each source class is provided in Section 3.0.5.3.1.2 (Explosives). The types of noise produced during weapons firing, launches, and non-explosive munitions impact are discussed in Section 3.0.5.3.1.3 (Weapons Firing, Launch, and Impact Noise).

Offshore Area

Under the No Action Alternative, marine invertebrates would be exposed to explosions at or beneath the water surface and underwater impulse noise from weapons firing, launches, and impacts of non-explosive munitions during training activities. Noise would be produced by explosions, weapons firing, launches, and impacts of non-explosive munitions throughout the Offshore Area of the Study Area.

In general, explosive events would consist of a single explosion or a few smaller explosions over a short period. Some marine invertebrates close to a detonation would likely be killed, injured, damaged, or displaced. Most detonations would occur greater than 12 nautical miles (nm) from shore, and less than 1 percent would occur in Inland Waters. As water depth increases away from shore, benthic and pelagic invertebrates would be less likely to be impacted by detonations at or near the surface. Pelagic marine invertebrates are generally disturbed, rather than struck, as the water flows around the vessel or in-water device. Shockwaves created by explosions would impact invertebrates in a similar way, causing them to be disturbed rather than struck as water flows from around the explosion. In addition, detonations near the surface would release a portion of their explosive energy into the air, reducing the explosive impacts in the water.

Many corals and hardbottom invertebrates are sessile, fragile, and particularly vulnerable to shock wave impacts. Many of these organisms are slow-growing and could require decades to recover (Precht et al. 2001). Explosive impacts on benthic invertebrates are more likely when an explosive is large compared to the water depth or when an explosive is detonated at or near the bottom; however, explosions would occur at or near the water surface of deep waters as they are meant to explode in the water column, and not on the seafloor, reducing the likelihood of bottom impacts.

Noise produced by weapons firing, launches, and impacts of non-explosive munitions would consist of a single or several impulses over a short period and would likely not be injurious. Some marine invertebrates may be sensitive to the low-frequency component of impulse sound, and they may exhibit startle reactions or temporary changes in swim speed in response to an impulse exposure. Because exposures are brief, limited in number, and spread over a large area, no long-term impacts due to explosions are expected under the No Action Alternative. Although individual marine invertebrates may be injured or killed during an explosion, no long-term impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected from training activities under the No Action Alternative.

Inland Waters

Under the No Action Alternative, marine invertebrates would be exposed to explosions at or beneath the water during training activities. Noise could be produced by explosions and weapons firing in the Inland Waters of the Study Area.

Explosive events under the No Action Alternative would consist of a single explosion. Some marine invertebrates close to a detonation would likely be killed, injured, damaged, or displaced. The detonations would occur in Hood Canal and Crescent Harbor. As water depth increases away from the shoreline, benthic invertebrates would be less likely to be impacted by detonations at or near the surface.

Many hardbottom invertebrates are sessile, fragile, and particularly vulnerable to shock wave impacts. Many of these organisms are slow-growing and could require decades to recover (Precht et al. 2001). Explosive impacts on benthic invertebrates are more likely when an explosive is large compared to the water depth or when an explosive is detonated at or near the bottom; however, most explosions would occur at or near the water surface over soft bottom areas of deep waters and, as they are meant to explode in the water column, and not on the seafloor, that would further reduce the likelihood of bottom impacts.

Because exposure to explosions would be brief and limited in number, no population level impacts from training activities are expected under the No Action Alternative. Although individual marine invertebrates may be injured or killed during an explosion, no population level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under the No Action Alternative.

Testing Activities

Offshore Area

Under the No Action Alternative, no testing activities involving explosions would occur in the Offshore Area of the Study Area. Therefore, marine invertebrates would not be exposed to explosions during testing activities.

Inland Waters

Under the No Action Alternative, marine invertebrates would not be exposed to explosions or weapons firing during testing activities in the Inland Waters of the Study Area. Therefore, explosions would have no impact to marine invertebrates under the No Action Alternative.

3.8.3.1.2.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, marine invertebrates would be exposed to explosions at or beneath the water surface and underwater impulse noise from weapons firing, launches, and impacts of non-explosive munitions during training activities in the Offshore Area of the Study Area. Although the number of explosives used in training activities would increase by about 39 percent compared to training activities under the No Action Alternative, these activities would generally occur in the same areas as under the No Action Alternative (see Table 3.8-2).

More marine invertebrates could be exposed to explosions at or near the water surface and underwater impulse noise due to weapons firing, launches, and non-explosive munitions impacts under Alternative 1; however, the type of impacts to individual marine invertebrates from training activities are expected to remain the same as those described above in the No Action Alternative. Even though individual marine invertebrates may be injured or killed during an explosion, no population level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

Inland Waters

Under Alternative 1, marine invertebrates would be exposed to explosions at or beneath the water surface and underwater impulse noise from weapons firing during training activities in the Inland Waters.

Explosives training would increase from two 2.5 lb. and two 1.5 lb. underwater detonations at Crescent Harbor and Hood Canal under the No Action Alternative, respectively, to three 2.5 lb. underwater detonations at each location under Alternative 1. Additionally, under Alternative 1, six annual events would take place (three each at Crescent Harbor and Hood Canal) in which up to six shock wave action generators (SWAG) would be used per event. No SWAG events occur under the No Action Alternative. Each SWAG consists of a small explosive charge of less than one-half ounce. Of the increase in underwater detonations from the No Action Alternative to Alternative 1, 36 of the 38 would be these much smaller SWAG detonations.

Training in which weapons firing occurs includes two new activities under Alternative 1 that would not occur under the No Action Alternative. Four surface-to-surface gunnery exercises would take place annually in which a total of 1,500 small-caliber blank rounds would be fired. Although this exercise involves only blanks, the weapons firing noise is similar to that when actual rounds are fired. The second new activity is a small boat attack exercise proposed to occur once per year at Naval Station Everett, Naval Base (NAVBASE) Kitsap Bangor, or NAVBASE Kitsap Bremerton. In this activity, 3,000 small-caliber blank rounds would be fired.

More marine invertebrates could be exposed to explosions at or near the water surface and underwater impulse noise due to weapons firing, launches, and non-explosive munitions impacts; however, the type of impacts from training activities to individual marine invertebrates under Alternative 1 are expected to remain the same as those described above in the No Action Alternative. Even though individual marine invertebrates may be injured or killed during an explosion, no population level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

Testing Activities

Offshore Area

Under Alternative 1, marine invertebrates would be exposed to explosions at or beneath the water surface and underwater impulse sounds due to explosive and non-explosive munitions used during testing activities conducted by Naval Sea Systems Command (NAVSEA) and Naval Air Systems Command (NAVAIR) (see Tables 2.8-2 and 2.8-3).

The only explosives that would be used in the Offshore Area would be beyond 12 nm from shore, due to testing activities using explosive sonobuoys and explosive torpedoes. The number of explosive sonobuoys used in testing activities would increase from 0 in the No Action Alternative to 142 in Alternative 1. The number of explosive torpedoes would increase from zero in the No Action Alternative to six in Alternative 1.

Although more marine invertebrates would be exposed to explosions and impulse noise due to weapons firing, launches, and non-explosive munitions impacts under Alternative 1, the type of impacts to individual marine invertebrates from testing activities are expected to remain the same as those described for training. Because impulse exposures are brief, limited in number, and spread over a large area, no population level impacts due to startle reactions are expected under Alternative 1. Although individual marine invertebrates may be injured or killed during an explosion, no population level impacts

on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 1.

Inland Waters

Under Alternative 1, no underwater explosions or weapons firing testing activities would take place in the Inland Waters. Therefore, the impacts would be the same as those described under the No Action Alternative.

3.8.3.1.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the number of training activities and number of underwater explosions would be the same as under Alternative 1 in the Offshore Area of the Study Area. Therefore, Alternative 2 would have the same impacts as under Alternative 1 in the Offshore Area.

Inland Waters

Under Alternative 2, the type and number of training activities involving weapons firing and underwater explosions in the Inland Waters would be the same as under Alternative 1. Therefore, Alternative 2 would have the same impacts as under Alternative 1.

Testing Activities

Offshore Area

Under Alternative 2, marine invertebrates would be exposed to explosions at or beneath the water surface and increased amounts of underwater impulse sounds due to explosive and non-explosive munitions used during testing activities.

The only explosives that would be used in the Offshore Area due to testing activities would be explosive sonobuoys and explosive torpedoes. The number of explosive sonobuoys used in testing activities would increase from 0 in the No Action Alternative to 156 in Alternative 2. The number of explosive torpedoes would increase from zero in the No Action Alternative to eight in Alternative 2.

Although more marine invertebrates could be exposed to explosions and impulse noise due to explosive and non-explosive munitions impacts, the type of impacts to individual marine invertebrates from testing activities are expected to remain the same as those described above in Alternative 1. Because impulse exposures are brief, limited in number, and spread over a large area, no long-term impacts due to startle reactions are expected under Alternative 2. Although individual marine invertebrates may be injured or killed during an explosion, no population level impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected under Alternative 2.

Inland Waters

Under Alternative 2, no underwater explosions or weapons firing testing activities would take place in the Inland Waters; therefore, Alternative 2 would have the same impacts as under the No Action Alternative.

3.8.3.1.2.4 Substressor Impact on Sedentary Invertebrate Beds and Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives and other impulse sources during training and

testing activities may have an adverse effect on EFH by reducing the quality or quantity of sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The use of other impulse sources (weapons firing, launch, and impact noise) during training and testing activities would not have an adverse effect on EFH by reducing the quality or quantity of sedentary invertebrate beds or offshore reefs that constitute EFH or Habitat Areas of Particular Concern within the Study Area.

3.8.3.1.3 Summary of Effects from Acoustic Stressors

Under the No Action Alternative, Alternative 1, or Alternative 2, exposures to sound-producing and explosive stressors would occur within the Study Area. The Navy identified and analyzed the following acoustic and explosive stressors that could impact marine invertebrates: sonar, other active acoustic sources, vessel noise, aircraft noise, noise from explosions, weapons firing, weapons launches, and non-explosive water surface impact noise. Both pelagic and benthic marine invertebrates could be impacted by these stressors. In most cases, marine invertebrates would not respond to impulse and non-impulse sounds, although they may detect and briefly respond to nearby low-frequency sounds. These short-term responses would likely be inconsequential. Explosions could kill or injure nearby marine invertebrates. Explosions near the seafloor and very large explosions in the water column may impact shallow-water corals, mollusk beds, hardbottom habitat and associated marine invertebrates, and deep-water corals from physical disturbance, fragmentation, or mortality. Most explosions at the water surface would not injure benthic marine invertebrates because the explosive weights would be small compared to the water depth.

3.8.3.2 Energy Stressors

This section analyzes the potential impacts of the various types of energy stressors that can occur during training and testing activities within the Study Area. This section includes analysis of the potential impacts from electromagnetic devices.

3.8.3.2.1 Impacts from Electromagnetic Devices

Several different types of electromagnetic devices are used during training and testing activities. For a discussion of the types of activities that use electromagnetic devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.2.1 (Electromagnetic). Aspects of electromagnetic stressors that are applicable to marine organisms in general are presented in Appendix H, Section H.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities).

Little information exists about marine invertebrates' susceptibility to electromagnetic fields. Some arthropods (e.g., spiny lobster and American lobster) can sense magnetic fields, and this ability is thought to assist the animal with navigation and orientation (Lohmann et al. 1995, Normandeau et al. 2011). These animals travel relatively long distances during their lives, and magnetic field sensation may exist in other invertebrates that travel long distances. Marine invertebrates, including several commercially important species and federally managed species, could use magnetic cues (Normandeau et al. 2011). Susceptibility experiments have focused on arthropods, but several mollusks and echinoderms are also susceptible. However, because susceptibility is variable within taxonomic groups it is not possible to make generalized predictions for groups of marine invertebrates. Sensitivity thresholds vary by species ranging from 0.3 to 30 milliteslas, and responses included non-lethal physiological and behavioral changes (Normandeau et al. 2011). The primary use of magnetic cues seems to be navigation and orientation. Human-introduced electromagnetic fields could disrupt these cues and interfere with navigation, orientation, or migration. Because electromagnetic fields weaken exponentially with increasing distance from their source, large and sustained magnetic fields present greater exposure risks

than small and transient fields, even if the small field is many times stronger than the earth's magnetic field (Normandeau et al. 2011). Transient or moving electromagnetic fields may cause temporary disturbance to susceptible organisms' navigation and orientation.

No testing activities would involve the use of electromagnetic devices under any alternative. Therefore, only training activities will be evaluated.

No training activities in the Offshore Area of the Study Area would involve electromagnetic devices under any alternative. Therefore, electromagnetic devices would have no impact to marine invertebrates in the Offshore Area under any alternative.

3.8.3.2.1.1 No Action Alternative

Training Activities

Inland Waters

No training or testing activities involving electromagnetic devices would occur in the Inland Waters under the No Action Alternative. Therefore, electromagnetic devices would have no impact to marine invertebrates under the No Action Alternative.

3.8.3.2.1.2 Alternative 1

Training Activities

Inland Waters

Table 3.0-16 lists the number and location of training activities that use electromagnetic devices. As indicated in Section 3.0.5.3.2.1 (Electromagnetic), under Alternative 1, training activities involving electromagnetic devices occur during Civilian Port Defense as part of mine warfare. Training activities that use electromagnetic devices would occur in the Inland Waters portion of the Study Area once every other year.

The impact of electromagnetic fields on marine invertebrates under Alternative 1 would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the number of activities involving the stressor is low; (3) exposures would be localized, temporary, and would cease with the conclusion of the activity; and (4) even for susceptible invertebrates (e.g., some species of arthropods, mollusks, and echinoderms), the consequences of exposure are limited to temporary disruptions to navigation and orientation under Alternative 1.

3.8.3.2.1.3 Alternative 2

Training Activities

Inland Waters

Table 3.0-16 lists the number and location of training activities that use electromagnetic devices. As indicated in Section 3.0.5.3.2.1 (Electromagnetic), under Alternative 2, training activities involving electromagnetic devices occur during Civilian Port Defense as part of mine warfare. Training activities that use electromagnetic devices would occur in the Inland Waters portion of the Study Area and would increase to once per year, compared to once every other year under the No Action Alternative.

The impact of electromagnetic fields on marine invertebrates would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the number of activities involving the stressor is low; (3) exposures would be localized, temporary, and would cease with the conclusion of the activity; and (4) even for susceptible invertebrates (e.g., some

species of arthropods, mollusks, and echinoderms) the consequences of exposure are limited to temporary disruptions to navigation and orientation under Alternative 2.

3.8.3.2.1.4 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitat

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of electromagnetic devices during training and testing activities would have minimal and temporary adverse effects on invertebrates that occupy water column EFH or Habitat Areas of Particular Concern, and would have no adverse effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern within the Study Area.

3.8.3.2.2 Summary of Effects from Energy Stressors

Exposures to energy stressors are limited spatially and temporally. Available evidence suggests that many marine invertebrates are not susceptible to electromagnetic fields. If susceptible invertebrates are near an electromagnetic source and if they sense the electromagnetic field, it could interfere with navigation and orientation. Because exposures would be temporary and cease with the conclusion of the activity, electromagnetic sources would not impede or disrupt the overall ability of marine invertebrates to navigate, orient, or migrate.

3.8.3.3 Physical Disturbance and Strike

This section analyzes the potential impacts of the various types of physical disturbance and strike stressors used by Navy during training and testing activities within the Study Area. For a list of locations and numbers of activities that may cause physical disturbance and strikes refer to Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). The physical disturbance and strike stressors that may impact marine invertebrates include (1) vessels and in-water devices, and (2) military expended materials.

Most marine invertebrate populations extend across wide areas containing hundreds or thousands of discrete patches of suitable habitat. Sessile (attached to the seafloor) invertebrate populations may be maintained by complex currents that carry adults and young from place to place. Such widespread populations are difficult to evaluate in terms of Navy training and testing activities that occur in relatively small areas of the Study Area. In this context, a physical strike or disturbance would impact individual organisms directly or indirectly, but not to the extent that the viability of populations or species would be impacted.

Activities involving vessels and in-water devices are not intended to contact the seafloor; there is no potential strike impact and limited potential disturbance impact on benthic or habitat-forming marine invertebrates.

With the exception of corals, mollusk beds, and other sessile benthic invertebrates, most invertebrate populations recover quickly from disturbance. Many large invertebrates, such as crabs, shrimps, and clams, undergo massive disturbance during commercial and recreational harvests. Other invertebrates, such as the small soft-bodied organisms that live in the bottom sediment, are thought to be well-adapted to natural physical disturbances, although recovery from some human-induced disturbances such as trawl fishing can be delayed by decades or more (Lindholm et al. 2011). Both of these populations would recover from a strike or other disturbance on scales of weeks to years. Biotic habitats, such as deep-sea coral and sponge communities, may take decades to re-grow following a strike or disturbance (Precht et al. 2001).

3.8.3.3.1 Impacts from Vessels and In-Water Devices

The majority of the training activities under all the alternatives involve vessels, and a few of the activities involve the use of in-water devices. For a listing of the number and location of activities that use vessels and in-water devices, see Tables 3.0-18 and 3.0-20. See Table 3.0-17 for a representative list of Navy vessel sizes and speeds and Table 3.0-19 for the types, sizes, and speeds of Navy in-water devices used in the Study Area.

Vessels and in-water devices could impact marine invertebrates by disturbing the water column or sediments, or directly striking organisms (Bishop 2008). The propeller wash (water displaced by propellers used for propulsion) from vessel movement and water displaced from vessel hulls could disturb marine invertebrates in the water column, and is a likely cause of zooplankton mortality (Bickel et al. 2011). This local and short-term exposure to vessel and propeller movements could displace, injure, or kill zooplankton, invertebrate eggs or larvae, and macro-invertebrates in the upper portions of the water column.

Few sources of information are available on the impact of non lethal chronic disturbance on marine invertebrates. One study of seagrass-associated marine invertebrates, such as amphipods and polychaetes, found that chronic disturbance from vessel wakes resulted in the long-term displacement of some marine invertebrates from the impacted area (Bishop 2008). Impacts of this type resulting from repeated exposure in shallow water are not likely to result from Navy training and testing activities because (1) most vessel movements occur in relatively deep water, and (2) vessel movements are concentrated in well-established port facilities and associated channels (Mintz and Parker 2006).

Vessels and towed in-water devices do not normally collide with invertebrates that inhabit the seafloor because Navy vessels are operated in relatively deep waters and have navigational capabilities to avoid contact with these habitats. A consequence of vessel operation in shallow water is increased turbidity from resuspending bottom sediments. Turbidity can impact invertebrate communities on hardbottom areas by reducing the amount of light that reaches these organisms and by clogging siphons for filter feeding organisms. Encrusting organisms residing on hardbottom can be impacted by persistent silting from increased turbidity. In addition, propeller wash and accidental physical contact with hardbottom areas can cause structural damage to the substrate as well as mortality to encrusting organisms. While information on the frequency of vessel operations in shallow water is not adequate to support a specific risk assessment, typical navigational procedures minimize the likelihood of contacting the seafloor, and most Navy vessel movements in nearshore waters are confined to established channels and ports, or predictable transit lanes. Pelagic marine invertebrates are generally disturbed, rather than struck, as the water flows around the vessel or in-water device.

Unmanned underwater vehicles travel at relatively low speeds, and are smaller than most vessels, making the risk of strike or physical disturbance to marine invertebrates very low. These in-water devices would occur primarily over soft-bottom habitats; their effect would be temporary and localized, very short in duration, and would not alter the habitat's ability to function, although they would create a temporary disturbance in the vicinity of the device. Zooplankton, invertebrate eggs or larvae, and macro-invertebrates in the water column could be displaced, injured, or killed by unmanned underwater vehicle movements.

Potential impacts of precision anchoring are qualitatively different than other seafloor devices because the activity involves repeated disturbance to the same area of seafloor. Precision anchoring occurs in

long-established soft-bottom areas that have a history of disturbance by anchors, and continued exposure is likely to be inconsequential and not detectable.

There are no training activities proposed in the Western Behm Canal portion of the Study Area under any Alternative. Therefore, vessels and in-water devices would have no impact on marine invertebrates under any Alternative.

3.8.3.3.1.1 No Action Alternative

Training Activities

As indicated in Sections 3.0.5.3.3.1 (Vessels) and 3.0.5.3.3.2 (In-Water Devices), the training activities include vessels and in-water devices.

Offshore Area

Under the No Action Alternative, activities that include in-water devices would occur during training activities in the Offshore Area.

Species that do not occur near the surface within the Study Area would not be exposed to vessel strikes. Species that do occur near the surface within the Study Area would have the potential to be exposed to vessel strikes. Large, slow vessels would pose little risk to marine invertebrates in the open ocean although, in coastal waters, currents from large vessels may cause resuspension and settlement of sediment onto sensitive invertebrate communities. Vessels travelling at high speeds would generally pose more of a risk through propeller action in shallow waters.

There would be a higher likelihood of vessel strikes over the continental shelf portions of the Study Area because of the concentration of vessel movements in those areas. Exposure of marine invertebrates to vessel disturbance and strikes is primarily limited to organisms in the uppermost portions of the water column. Invertebrates that occur on the seafloor, including hardbottom and deep-water corals, are not likely to be exposed to this stressor because they typically occur at depths greater than that potentially impacted by vessels.

The impact of vessels on marine invertebrates under the No Action Alternative would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Training activities involving vessels are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

Within the Inland Waters, these activities would be more concentrated near naval ports, piers and ranges. The vessels used in the Inland Waters during training would be small boats and submersibles. Under the No Action Alternative, four activities that include vessel movement would occur during training activities in the Inland Waters; no activities would include in-water devices.

Vessels travelling at high speeds would generally pose more of a risk through propeller action in shallow waters. Under the No Action Alternative, these shallow-water vessels would continue to operate in defined boat lanes with sufficient depths to avoid propeller or hull strikes of benthic invertebrates.

Under the No Action Alternative, the impact of vessels and in-water devices on marine invertebrates would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is very low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Training activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Testing Activities

Offshore Area

Under the No Action Alternative, 37 activities that include vessel movement and 40 activities that include in-water devices would occur during testing activities in the Offshore Area. Surf zone activities would occur in the Offshore Area of the Study Area at Pacific Beach in the Quinault Range Site, which extends north to south 5 nm along the eastern boundary of W-237A, approximately 3 nm to shore along the mean low water line, and encompasses 1 mi. (1.6 km) of shoreline at Pacific Beach, Washington. Surf zone activities would be conducted from an area on the shore going toward the sea. Surf zone activities include the use of bottom-crawling unmanned vehicles and have the potential to affect marine invertebrates located on the seafloor or floating in the water column, since the crawlers are moving through the water column.

The impact of vessels and in-water devices on marine invertebrates under the No Action Alternative would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

Within the Inland Waters, these activities would be more concentrated near naval ports, piers, and ranges. Some of these activities would involve the use of in-water devices that may crawl along the sea floor. Under the No Action Alternative, 337 activities that include vessel movement and 379 activities that include in-water devices would occur during testing activities, and no activities using crawlers would occur in the Inland Waters.

The impact of vessels and in-water devices on marine invertebrates would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Western Behm Canal, Alaska

Within the Western Behm Canal portion of the Study Area, these activities would only involve vessel movements. Under the No Action Alternative, 28 annual testing activities that include vessel movement would occur in the Western Behm Canal.

The impact of vessels on marine invertebrates in the Western Behm Canal portion of the Study Area would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

3.8.3.3.1.2 Alternative 1

Training Activities

Offshore Area

The vessels and in-water devices used during training activities under Alternative 1 would increase from 1,425 activities under the No Action Alternative to 1,572 activities. These activities would be widely dispersed throughout the Offshore Area of the Study Area.

Despite the increase in training activities over the No Action Alternative, the impact of vessels and in-water devices on marine invertebrates would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Under Alternative 1, activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting impacts on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

These activities could be widely dispersed throughout the Inland Waters, but would be more concentrated near naval ports, piers, and ranges. Activities involving vessels and in-water devices would increase from four under the No Action Alternative to 28 under Alternative 1 (see Table 3.8-2).

The vessels and in-water devices used during training activities under Alternative 1 would be similar to those described under the No Action Alternative; however, there would be an increase in activities from the No Action Alternative to Alternative 1. The impact of vessels and in-water devices on marine invertebrates would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Training activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Testing Activities

Offshore Area

Vessel movements and in-water devices used during NAVSEA testing activities (Table 2.8-2) include new activities not proposed under the No Action Alternative, including explosive torpedo testing, countermeasure testing, and anti-submarine warfare testing. However, each of these new activities is similar to training or testing that is historically conducted in the Offshore Area. Under Alternative 1, 138 activities that include vessel movement and 154 activities that include in-water devices would occur during testing activities, representing increases of 101 and 110 annual activities from the No Action Alternative, respectively.

Similar to testing activities under the No Action Alternative, the impact of vessels and in-water devices on marine invertebrates would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Under Alternative 1, testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

Within the Inland Waters, these activities would be more concentrated near naval ports, piers and ranges. Some of these activities would involve the use of in-water devices that may crawl along the sea floor. Activities involving vessels and in-water devices would increase from 337 under the No Action Alternative to 582 under Alternative 1. Despite this increase, the impact of vessels and in-water devices on marine invertebrates would be minimal because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Western Behm Canal, Alaska

Navy vessel movements would occur in the Western Behm Canal portion of the Study Area during testing activities under Alternative 1. These activities would increase from 28 under the No Action Alternative to 60 under Alternative 1.

Despite this increase, the impact of vessels and in-water devices on marine invertebrates under Alternative 1 would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device’s footprint, and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

3.8.3.3.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, training activities would be the same quantity as Alternative 1. Therefore, Alternative 2 would have the same impacts to marine invertebrates as under Alternative 1.

Inland Waters

Under Alternative 2, training activities involving vessels and in-water devices would be consistent with Alternative 1 (see Table 3.8-2) as the numbers of activities are the same. Therefore, Alternative 2 would have the same impacts to marine invertebrates as under Alternative 1.

Testing Activities

Offshore Area

Under Alternative 2, 162 activities that include vessel movement and 183 activities that include in-water devices would occur during testing activities, representing increases of 24 and 29 annual activities from the No Action Alternative, respectively. Although the tempo of activities increases slightly, and more individuals could be affected, the overall population impacts are the same as under Alternative 1 because of the short duration of events, the time for recovery between events, and the very limited portion of the population affected. Under Alternative 2, testing activities would be consistent with Alternative 1. Therefore, Alternative 2 would have the same effects as under Alternative 1.

Inland Waters

The vessels and in-water devices used during testing activities under Alternative 2 would increase by approximately 10 percent but are similar to those described under Alternative 1. Despite this slight increase, impacts from testing activities under Alternative 2 would be similar to Alternative 1 for these reasons: (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Therefore, impacts to marine invertebrates under Alternative 2 from vessel strikes and in-water devices would be similar to Alternative 1.

Western Behm Canal, Alaska

Navy vessel movements would occur in the Western Behm Canal portion of the Study Area during testing activities under Alternative 2. These activities would increase from 28 under the No Action Alternative to 83 under Alternative 2.

Despite this increase, the impact of vessels and in-water devices on marine invertebrates under Alternative 2 would be inconsequential because (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device’s footprint and is extremely small relative to most marine invertebrates' ranges; (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event; and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Testing activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

3.8.3.3.1.4 Substressor Impact on Sedentary Invertebrate Beds and Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of vessels and in-water devices during training and testing activities would have no effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern within the Study Area.

3.8.3.3.2 Impacts from Military Expended Materials

This section analyzes the strike potential to invertebrates from the following categories of military expended materials: (1) non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expended materials other than ordnance, such as sonobuoys, vessel hulks, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.3 (Military Expended Material).

Military expended materials are deposited throughout the Study Area. However, the majority of military expended materials are deposited within the Offshore Area, and the Inland Waters, with no military expended materials being deposited in the Western Behm Canal portion of the Study Area. These areas of higher military expended materials deposition are generally away from the coastline but on the continental shelf and slope.

Chaff and flares include canisters, end-caps, and aluminum coated glass fibers. Chaff, in particular, may be transported great distances by the wind, beyond the areas where they are deployed before contacting the sea surface. These materials contact the sea surface and seafloor with very little kinetic energy and their low buoyant weight makes them a negligible strike and abrasion risk. Aerial countermeasures, therefore, will not be addressed as potential strike and disturbance stressors.

Physical disturbances or strikes by military expended materials on marine invertebrates are possible at the water's surface, through the water column, and on the seafloor. Disturbance or strike impacts on marine invertebrates by military expended materials falling through the water column are possible, but not very likely because military expended materials do not generally sink rapidly enough to cause strike injury (i.e., as opposed to fragments propelled by high explosives); and exposed invertebrates would likely experience only temporary displacement as the object passes by. Therefore, the discussion of military expended materials disturbance and strikes will focus on military expended materials at the water's surface and on the seafloor. While marine invertebrates on the seafloor may be impacted by military expended materials propelled by high explosives, this event is not very likely except for mine warfare detonations, which typically occur at or near the seafloor. Sessile marine invertebrates and infauna are particularly susceptible to military expended material strikes, including deep-water corals, since these species cannot move away from disturbances.

Munitions

Small-, Medium-, and Large-Caliber Projectiles

Various types of projectiles could cause a temporary local impact when they strike the surface of the water. Navy training in the Study Area, such as gunnery exercises, include firing a variety of weapons and using a variety of non-explosive training and testing rounds, small-, medium-, and large-caliber projectiles. Large-caliber projectiles are primarily used in the open ocean beyond 20 nm.

Direct ordnance strikes from firing weapons are potential strike stressors to marine invertebrates. Military expended materials could impact the water with great force and produce a large impulse. Physical disruption of the water column is a local, temporary impact, and would be limited to a small area (within a radius of tens of meters) around the impact point, persisting for a few minutes. Physical and chemical properties of the surrounding water would be temporarily altered (e.g., slight heating or cooling and increased oxygen concentrations due to turbulent mixing with the atmosphere), but there would be no lasting change resulting in long-term impacts on marine invertebrates. Although the sea surface is rich with invertebrates, most are zooplankton and relatively few are large pelagic invertebrates (e.g., some jellyfish, squid, and some swimming crabs). Zooplankton, eggs and larvae, and larger pelagic organisms in the upper portions of the water column could be displaced, injured, or killed by military expended materials impacting the sea surface. Individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations or species would be impacted, primarily because the number of organisms exposed to these devices is extremely small relative to population sizes.

Marine invertebrates on the seafloor could be displaced, injured, or killed by military expended materials contacting the seafloor. While all marine invertebrates living on or in the seafloor are susceptible to disturbance, strikes, and burial by military expended materials, only sessile (attached to the seafloor) marine invertebrates are susceptible to impact by abrasion. Parachutes are the principal source of abrasion stressors to marine invertebrates, and these are addressed separately because the nature of their potential impacts is materially different than other military expended materials.

Projectiles present the greatest risk of long-term damage to marine invertebrates compared with other seafloor communities because (1) many invertebrates are sessile, fragile, and particularly vulnerable; (2) many of these organisms grow slowly, and could require decades to recover (Precht et al. 2001); and (3) military expended materials are likely to remain mobile for a longer period because natural encrusting and burial processes are much slower on these habitats than on hardbottom habitats.

Bombs, Missiles, and Rockets

Bombs, missiles, and rockets are potential strike stressors to marine invertebrates. The nature of their potential impacts is the same as projectiles. However, they are addressed separately because they are larger than most projectiles, and because high-explosive bombs, missiles, and rockets are likely to produce a greater number of small fragments than projectiles. Propelled fragments are produced by high explosives. Close to the explosion, invertebrates could be injured by propelled fragments. However, studies of underwater bomb blasts have shown that fragments are larger than those produced during air blasts and decelerate much more rapidly (O'Keeffe and Young 1984; Swisdak Jr. and Montaro 1992), reducing the risk to marine organisms. Bombs, missiles, and rockets are designed to explode within 3 ft. (1 m) of the sea surface where marine invertebrates are relatively infrequent. The fitness of individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations or species would be impacted, primarily because the number of organisms exposed to these devices would be extremely small relative to population sizes.

Military Expended Materials other than Munitions

Vessel Hulk

During a sinking exercise, aircraft, ship, and submarine crews deliver ordnance on a surface target, which is a clean (see Section 3.1, Sediments and Water Quality), deactivated ship deliberately sunk using multiple weapon systems. Sinking exercises occur in specific open ocean areas, outside of the coastal range complexes. Ordnance strikes by the various weapons used in these exercises are a potential

source of impacts. However, these impacts are discussed for each of those weapons categories in this section and are not repeated here. Therefore, the analysis of sinking exercises as a strike potential for benthic invertebrates is discussed in terms of the vessel hulk landing on the seafloor. The primary difference between a vessel hulk and other military expended materials as a strike potential for marine invertebrates is a difference in scale. As the vessel hulk settles on the seafloor, all marine invertebrates within the footprint of the hulk would be impacted by strike or burial, and invertebrates a short distance beyond the footprint of the hulk would be disturbed. A vessel hulk may also change ocean flow patterns, sediment transport, and benthic communities (by creating new suitable hard substrate for attachment and colonization). Habitat-forming invertebrates (i.e., corals) are likely absent where sinking exercises are planned because this activity occurs in depths greater than the range of corals and most other habitat-forming invertebrates (approximately 10,000 ft. [3,048 m]) and away from hydrothermal vent communities (see Section 3.3, Marine Habitats).

Parachutes

Parachutes of varying sizes are used during training and testing activities. For a discussion of the types of activities that use parachutes, physical characteristics of these expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.4.2 (Parachutes). See Table 3.0-27 for information regarding the number and location of activities involving parachutes. Activities that expend sonobuoy and air-launched torpedo parachutes generally occur in water deeper than 600 ft. (180 m). Parachutes may impact marine invertebrates by disturbance, strikes, burial, smothering, or abrasion. Movement of parachutes in the water may break more fragile invertebrates such as deep-water corals.

Countermeasures

Defensive countermeasures such as chaff and flares are used to protect against missile and torpedo attack. Chaff is made of aluminum-coated glass fibers and flares are pyrotechnic devices. Chaff, chaff canisters, and flare end caps are expendable materials. Chaff and flares are dispensed from aircraft or fired from ships. Marine invertebrates may overlap with areas of chaff and flares that are expended in the near shore areas of the Study Area. Floating marine invertebrates could occur in any of the locations that these materials are expended.

No training or testing activities with military expended materials are proposed in the Western Behm Canal portion of the Study Area under the No Action Alternative, Alternative 1, or Alternative 2. Therefore, military expended materials would have no impact on marine invertebrates under any alternative.

3.8.3.3.2.1 No Action Alternative

Training Activities

Offshore Area

The number of military expended materials used in the Offshore Area of the Study Area and their impact footprints are detailed in Tables 3.3-4 and 3.8-2. Under the No Action Alternative there are 189,668 military expended materials deposited in the Offshore Area.

Military expended materials that are ordnance (e.g., bombs, missiles, rockets, projectiles, and associated fragments) may strike marine invertebrates at the sea surface or on the seafloor. Consequences of strike or disturbance may include injury or mortality, particularly within the footprint of the object as it contacts the seafloor. Secondary impacts are possible if military expended materials are mobilized by currents or waves, and would cease when the military expended materials are incorporated into the

seafloor by natural encrustation or burial processes. The fitness of individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations or species would be impacted primarily because the number of organisms exposed to these devices would be extremely small relative to population sizes.

During sinking exercises, pelagic invertebrates present near the water's surface in the immediate vicinity of the exercise have the potential to be injured or killed. Sinking exercise vessel hulks contacting the seafloor would result in mortality of marine invertebrates within the footprint of the hulk and disturbance or injury of marine invertebrates near the footprint of the hulk. Though the footprint of a sinking exercise is large relative to other military expended materials, the impacted area is extremely small relative to the spatial distribution of marine invertebrate populations. Sinking exercises would impact the fitness of individual organisms directly or indirectly, but not to the extent that the viability of populations or species would be impacted.

Activities occurring at depths less than 2,600 ft. (800 m) may impact deep-water corals and other marine invertebrate assemblages. Consequences from impacts of military expended materials on marine invertebrate assemblages may include breakage, injury, or mortality for each projectile or munitions (see Section 3.3, Marine Habitats). Parachutes may cause abrasion injury or mortality, or breakage. The fitness of individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations or species would be impacted.

The impact of military expended materials under the No Action Alternative on marine invertebrates is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would cease when the military expended material stops moving. Training activities involving military expended material are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

The number of military expended materials used in the Inland Waters under the No Action Alternative and their impact footprints are detailed in Tables 3.3-6 and 3.8-2. Under the No Action Alternative there are eight military expended materials deposited in the Inland Waters. Military expended materials, used in Crescent Harbor and Hood Canal, consist of mine neutralization underwater explosive charges and the targets used during the mine neutralization training. Impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would be focused on targets.

Testing Activities

Offshore Area

The number of military expended materials and their impact footprints are detailed in Tables 3.3-5 and 3.8-2.

Military expended materials may strike marine invertebrates at the sea surface or on the seafloor. Military expended materials would number approximately 621 under the No Action Alternative. Activities occurring at depths less than 2,600 ft. (800 m) may impact deep-water corals and other marine invertebrate assemblages. Consequences may include breakage, injury, or mortality for each projectile

or munitions (see Section 3.3, Marine Habitats). Parachutes and cables may cause abrasion injury or mortality and breakage. Consequences of strikes or disturbances may include injury or mortality, particularly within the footprint of the object as it contacts the seafloor. Individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations would be impacted, because the number of organisms exposed to these devices would be extremely small relative to population sizes.

The impact of military expended materials on marine invertebrates under the No Action Alternative is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would cease when the military expended material stops moving. Testing activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

Under the No Action Alternative, 446 expended items would be used for testing in the Inland Waters. Military expended materials may strike marine invertebrates at the sea surface or on the seafloor. Consequences of strikes or disturbances may include injury or mortality, particularly within the footprint of the object as it contacts the seafloor. Individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations or species would be impacted primarily, because the number of organisms exposed to these devices would be extremely small relative to population sizes.

The impact of military expended materials on marine invertebrates is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would cease when the military expended material stops moving. Testing activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

3.8.3.3.2.2 Alternative 1

Training Activities

Offshore Area

The number of military expended materials and their impact footprints are detailed in Tables 3.3-4 and 3.8-2. Alternative 1 would include a decrease in military expended materials compared to the No Action Alternative due to the removal of the two sinking exercises. However, the overall number of military expended materials increases from 189,668 under the No Action Alternative to 196,888 under Alternative 1 due to an increase in small caliber and chaff utilization.

Since the number of military expended materials used under Alternative 1 is similar compared to the No Action Alternative, the effects would be similar to those described under the No Action Alternative. The impact of military expended materials under Alternative 1 on marine invertebrates is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event,

and (3) exposures would be localized and would cease when the military expended material stops moving. Training activities involving military expended material are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

Although Alternative 1 would include an increase in the military expended materials (from 8 to 85 annually), all of the military expended materials consist of mine neutralization underwater explosive charges and the targets used during the mine neutralization training. In no case would either of these items pose a physical disturbance or strike hazard to marine invertebrates. Impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would be focused on targets.

Testing Activities

Offshore Area

The number of military expended materials and their impact footprints are detailed in Tables 3.3-5 and 3.8-2. Activities proposed under Alternative 1 would include the use of sonobuoys and parachutes because of the introduction of new testing activities. Military expended materials would increase from approximately 621 under the No Action Alternative to 2,511 under Alternative 1.

The probability of military expended material strikes on marine invertebrates would increase because of the increase in the number of military expended materials. The impact of military expended materials on marine invertebrates under Alternative 1 is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would cease when the military expended material stops moving. Testing activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Inland Waters

The amount of military expended materials used in the Inland Waters of the Study Area for Alternative 1 would increase by approximately 16 percent compared to the No Action Alternative. Despite this increase the impacts would be similar to those described under the No Action Alternative. Activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

3.8.3.3.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the Navy proposes the same type and tempo of activity resulting in the same quantity of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on marine invertebrates would be the same as for Alternative 1.

Inland Waters

Under Alternative 2, the Navy proposes the same type and tempo of activity resulting in the same quantity of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on marine invertebrates would be the same as for Alternative 1.

Testing Activities

Offshore Area

Military expended materials from testing activities would increase from approximately 621 under the No Action Alternative to 2,764 under Alternative 2. This equates to an approximately 10 percent increase in the numbers of military expended materials as described in Alternative 1. Therefore, despite this slight increase, the impacts of Alternative 2 testing activities on marine invertebrates would be similar to Alternative 1.

Inland Waters

The amount of military expended materials used in the Inland Waters of the Study Area for Alternative 2 would increase by approximately 27 percent compared to the No Action Alternative. Despite this increase the effects would be similar to those described under the No Action Alternative. Testing activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

3.8.3.3.2.4 Substressor Impact on Sedentary Invertebrate Beds and Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of military expended materials during training and testing activities may have an adverse effect on EFH by reducing the quality or quantity of sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The EFHA states that the impact to sedentary invertebrate beds would be minimal and long-term to permanent in duration (based on substrate impacts), whereas impacts to reefs would be individually minimal and permanent in duration within the Study Area.

3.8.3.3.3 Summary of Effects from Physical Disturbance and Strike Stressors

Exposures to physical disturbance and strike stressors occur primarily on the range complexes and testing ranges within the Study Area. The Navy identified and analyzed three physical disturbance or strike substressors that could impact marine invertebrates: vessel and in-water device strikes, and military expended materials. Vessel and in-water device strikes are unlikely to impact invertebrates other than plankton, while military expended materials strikes could impact resident benthic (seafloor) invertebrates. Because vessel and in-water device strikes impact only invertebrates in the water column it is unlikely to make population impacts in the Study Area. Military expended material strikes could impact benthic invertebrates; however, the impact range is not significant and should not have population-level impacts on marine invertebrates in the Study Area.

3.8.3.4 Entanglement Stressors

This section analyzes the potential entanglement impacts of the various types of expended materials used by the Navy during training and testing activities within the Study Area. Included are potential impacts from two types of military expended materials (1) cables and wires and (2) parachutes. Aspects

of entanglement stressors that are applicable to marine organisms in general are presented in Section 3.0.5.3.4 (Entanglement Stressors).

Most marine invertebrates are less susceptible to entanglement than fishes, sea turtles, and marine mammals due to their size, behavior, and morphology. Because even fishing nets which are designed to take marine invertebrates operate by enclosing rather than entangling, marine invertebrates seem to be somewhat less susceptible than vertebrates to entanglement (Chuenpagdee et al. 2003). A survey of marine debris entanglements found that marine invertebrates composed 16 percent of all animal entanglements (Ocean Conservancy 2010). The same survey cites potential entanglement in military items only in the context of waste-handling aboard ships, and not for military expended materials. Nevertheless, it is conceivable that marine invertebrates, particularly arthropods and echinoderms with rigid appendages, might become entangled in cables and guidance wires, and in parachutes.

3.8.3.4.1 Impacts from Fiber Optic Cables and Guidance Wires

Fiber optic cables are only expended during mine neutralization testing activities and torpedo guidance wires are used in training and testing activities. For a discussion of the types of activities that use guidance wires and fiber optic cables, physical characteristics of these expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires). Abrasion and shading-related impacts on sessile benthic (attached to the seafloor) marine invertebrates that may result from entanglement stressors are discussed with physical impacts in Section 3.8.3.3 (Physical Disturbance and Strike).

A marine invertebrate that might become entangled in cables and wires could be either temporarily confused and escape unharmed, could be held tightly enough that it could be injured during its struggle to escape, could be preyed upon while entangled, or could starve while entangled. The likelihood of these outcomes cannot be predicted with any certainty because interactions between invertebrate species and entanglement hazards are not well known. The potential entanglement scenarios are based on observations of how marine invertebrates are entangled in marine debris such as fishing gear, which is far more prone to tangling than guidance wire or fiber optic cable (Environmental Sciences Group 2005; Ocean Conservancy 2010). The small number of guidance wires and fiber optic cables expended across the Study Area results in an extremely low rate of potential encounter for marine invertebrates.

No training or testing activities involving the use of fiber optic cables or guidance wires are proposed under any alternative in the Western Behm Canal portion of the study area. Therefore, fiber optic cables or guidance wires would have no impact on marine invertebrates under any alternative.

3.8.3.4.1.1 No Action Alternative

Training Activities

Offshore Area

Table 3.0-26 lists the number and locations of activities that expend fiber optic cables and guidance wires under the No Action Alternative. Under the No Action Alternative, only two activities in the Offshore Area of the Study Area will expend guidance wires.

Given the low numbers used, most marine invertebrates would never be exposed to guidance wires under the No Action Alternative. The impact of guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event;

(3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, as most would be temporarily disturbed. Training activities involving guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Inland Waters

No training activities with fiber optic cables and guidance wires are proposed in the Offshore Area of the Study Area under the No Action Alternative.

Testing Activities

Offshore Area

Fiber optic cables and guidance wires expended during testing activities would be greater in number (16 events compared to 2 training activities) than is expended during training. Despite this slight increase, the impact of fiber optic cables and guidance wires to marine invertebrates would be the same as those analyzed for training activities under the No Action Alternative.

Inland Waters

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), there would be 105 activities that expend fiber optic cables and guidance wires under the No Action Alternative. The impact of cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges (see Figure 2.1-3); (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, and would simply be temporarily disturbed. Testing activities involving cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

3.8.3.4.1.2 Alternative 1

Training Activities

Offshore Area

Due to the removal of the SINKEX under Alternative 1, no training activities with fiber optic cables and guidance wires are proposed in the Offshore Area of the Study Area under Alternative 1.

Inland Waters

As indicated in Table 3.8-2, there would be one training activity (Civilian Port Defense), conducted once every 2 years, that would expend fiber optic cables or guidance wires under Alternative 1. Given the low numbers used, most marine invertebrates would never be exposed to a fiber optic cable or guidance wire. Under Alternative 1 the impact of fiber optic cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors and would not become entangled, and simply be temporarily disturbed. Activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Testing Activities

Offshore Area

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 1, the number of testing activities that expend fiber optic cables and guidance wires would increase from 16 under the No Action Alternative to 20 under Alternative 1. Despite this increase, as stated above in No Action Alternative, cables and guidance wires would not be expected to cause injury or mortality to marine invertebrate individuals.

Inland Waters

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 1, the number of testing activities that expend fiber optic cables and guidance wires would increase from 105 under the No Action Alternative to 122 under Alternative 1. Under Alternative 1, the impact of fiber optic cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, and would simply be temporarily disturbed. Testing activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

3.8.3.4.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the Navy proposes the same numbers and types of fiber optic cables and guidance wires as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on marine invertebrates would be the same as for Alternative 1.

Inland Waters

Under Alternative 2, the Navy proposes to conduct the Civilian Port Defense once per year. Given the low numbers used, most marine invertebrates would never be exposed to a cable or guidance wire. Under Alternative 2 the impact of fiber optic cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, and simply be temporarily disturbed. Training activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Testing Activities

Offshore Area

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 2, the number of testing activities that expend fiber optic cables and guidance wires would increase from 16 under the No Action Alternative to 24 under Alternative 2. Despite this increase, as stated above in No Action Alternative, cables and guidance wires would not be expected to cause injury or mortality to marine invertebrate individuals.

Inland Waters

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), the number of testing activities that expend fiber optic cables and guidance wires would increase from 105 under the No Action Alternative to 133 under Alternative 2. Under Alternative 2, the impact of fiber optic cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, and would simply be temporarily disturbed. Testing activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

3.8.3.4.2 Impacts from Parachutes

Parachutes of varying sizes are used during training and testing activities. For a discussion of the types of activities that use parachutes, physical characteristics of these expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.4.2 (Parachutes). Parachutes pose a potential, though unlikely, entanglement risk to susceptible marine invertebrates. The most likely method of entanglement would be a marine invertebrate crawling through the fabric or cord that would then tighten around it.

Abrasion and shading-related impacts on sessile benthic (attached to the seafloor) marine invertebrates that may result from entanglement stressors are discussed with physical impacts in Section 3.8.3.3 (Physical Disturbance and Strike). Potential indirect effects of the parachute being transported laterally along the seafloor are discussed in Section 3.8.3.6 (Secondary Stressors).

A marine invertebrate that might become entangled could be temporarily confused and escape unharmed, held tightly enough that it could be injured during its struggle to escape, preyed upon while entangled, or starved while entangled. The likelihood of these outcomes cannot be predicted with any certainty because interactions between invertebrate species and entanglement hazards are not well known. The potential entanglement scenarios are based on observations of how marine invertebrates are entangled in marine debris (Environmental Sciences Group 2005; Ocean Conservancy 2010). The number of parachutes expended across the Study Area is extremely small relative to the number of marine invertebrates, resulting in a low rate of potential encounter for marine invertebrates.

No training or testing activities involving the use of parachutes are proposed under any alternative in the Western Behm Canal portion of the Study Area. Therefore, parachutes would have no impact on marine invertebrates under any Alternative.

3.8.3.4.2.1 No Action Alternative

Training Activities

Tables 3.0-27 and 3.8-2 list the number and locations of expended parachutes under each alternative in the Offshore Area of the Study Area.

Offshore Area

Under the No Action Alternative, 8,382 parachutes would be used in the Offshore Area. Under the No Action Alternative, the impact of parachutes on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the

stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, and would simply be temporarily disturbed. Training activities involving parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Inland Waters

No training activities with parachutes are proposed in the Inland Waters portion of the Study Area under the No Action Alternative. Therefore, parachutes would have no impact on marine invertebrates under the No Action Alternative.

Testing Activities

Offshore Area

The number of expended parachutes in the Offshore Area of the Study Area is 17 under the No Action Alternative. Under the No Action Alternative, the impact of parachutes on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, therefore most would simply be temporarily disturbed. Testing activities involving parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Inland Waters

Four parachutes would be expended in the Inland Waters under the No Action Alternative. Under the No Action Alternative the use of these four parachutes on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are few and dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, and would simply be temporarily disturbed. Testing activities involving parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels under the No Action Alternative.

3.8.3.4.2.2 Alternative 1

Training Activities

Offshore Area

The number of expended parachutes used under Alternative 1 would be the same as those used under the No Action Alternative (8,382), and would have the same impacts as described under the No Action Alternative.

Inland Waters

No training activities with parachutes are proposed in the Inland Waters portion of the Study Area under Alternative 1. Therefore, parachutes would have no impact on marine invertebrates under Alternative 1.

Testing Activities

Offshore Area

The number of expended parachutes in the Offshore Area of the Study Area increases from 17 under the No Action Alternative to 1,229 under Alternative 1. This increase is due to the addition of NAVAIR testing activities (see Table 2.8-3), which would typically occur in deep waters offshore.

Under Alternative 1, the impact of parachutes on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges; (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event; (3) exposures would be localized; and (4) marine invertebrates are not particularly susceptible to entanglement stressors, therefore most would simply be temporarily disturbed. Testing activities involving parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Inland Waters

Under Alternative 1, the Navy proposes no change in the use of parachutes as described in the No Action Alternative. Therefore, the impacts of Alternative 1 testing activities on marine invertebrates would be the same as for the No Action Alternative.

3.8.3.4.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the Navy proposes the same type and tempo of activity resulting in the same quantity of parachutes as described in the No Action Alternative and Alternative 1 (8,382). Therefore, the impacts of Alternative 2 training activities on marine invertebrates would be the same as for Alternative 1.

Inland Waters

No training activities with parachutes are proposed in the Inland Waters portion of the Study Area under Alternative 2. Therefore, parachutes would have no impact on marine invertebrates under Alternative 2.

Testing Activities

Offshore Area

The number of expended parachutes under Alternative 2 would increase by approximately 9 percent compared to Alternative 1. This increase of 122 parachutes would result in the same effects as described under Alternative 1, and for the same reasons there is no effect in Alternative 2.

Inland Waters

Under Alternative 2, the Navy proposes to increase in the use of parachutes from four under the No Action Alternative to five under Alternative 2. Therefore, the impacts of Alternative 2 testing activities on marine invertebrates would be similar as for the No Action Alternative.

3.8.3.4.3 Summary of Effects from Entanglement Stressors

Based on the analysis presented above, the impact of entanglement on marine invertebrates is not likely to cause injury or mortality to individuals. The impacts would be minimal to marine invertebrates due to the small area exposed relative to the range of the invertebrates, the dispersed nature of the activities,

the limitation of exposures to only a local area, and because marine invertebrates are not particularly susceptible to entanglement stressors; therefore most would simply be temporarily disturbed.

3.8.3.5 Ingestion Stressors

3.8.3.5.1 Impacts from Military Expended Materials

This section analyzes the potential ingestion impacts of the various types of military expended materials used by the Navy during training and testing activities within the Study Area. Expended materials could be ingested by marine invertebrates in all large marine ecosystems and open ocean areas. Ingestion could occur at the surface, in the water column, or on the seafloor, depending on the size and buoyancy of the expended object and the feeding behavior of the animal. Floating material is more likely to be eaten by animals that feed at or near the water surface, while materials that sink to the seafloor present a higher risk to bottom-feeding animals. Marine invertebrates are universally present in the water and the seafloor, but the majority of individuals are smaller than a few millimeters (e.g., zooplankton, most roundworms, and most arthropods). Most military expended materials and fragments of military expended materials are too large to be ingested by marine invertebrates (see Tables 3.3-4 through 3.3-7 for the specific size of fragments). The potential for marine invertebrates to encounter fragments of ingestible size increases as the military expended materials degrades into smaller fragments.

If expended material is ingested by marine invertebrates, the primary risk is from a blocked digestive tract. Most military expended materials are relatively inert in the marine environment, and are not likely to cause injury or mortality via chemical effects (see Section 3.8.3.6, Secondary Stressors, for more information on the chemical properties of these materials).

The most abundant military expended material of ingestible size is chaff. Chaff is similar in form to fine human hair, and somewhat analogous to the spicules of sponges or the siliceous cases of diatoms (Spargo 1999). Many invertebrates ingest sponges, including the spicules, without suffering harm (Spargo 1999). Marine invertebrates may occasionally encounter chaff fibers in the marine environment and may incidentally ingest chaff when they ingest prey or water. Literature reviews and controlled experiments suggest that chaff poses little environmental risk to marine organisms at concentrations that could reasonably occur from military training and testing (Arfsten et al. 2002, Spargo 1999). Laboratory studies were conducted to determine the likely effects on marine invertebrates from ingesting chaff, using crabs that were fed radio frequency chaff. Blue crabs were force-fed a chaff-and-food mixture daily for a few weeks at concentrations 10 to 100 times the predicted real-world exposure levels without a notable increase in mortality (Arfsten et al. 2002).

As described in Section 3.8.2 (Affected Environment), tens of thousands of marine invertebrate species inhabit the Study Area. There is little literature about the effects of debris ingestion on marine invertebrates; consequently, there is little basis for an evidence-based assessment of risks. It is not feasible to speculate on which invertebrates in which locations might ingest specific types of military expended materials. However, invertebrates that actively forage (e.g., worms, octopus, shrimp, and sea cucumbers) are at much greater risk of ingesting military expended materials than invertebrates that filter-feed (e.g., sponges, corals, oysters, and barnacles). Though ingestion is possible in some circumstances, based on the little scientific information available, negative impacts on individuals are unlikely and impacts on populations would be inconsequential and not detectable. Adverse consequences of marine invertebrates ingesting military expended materials are possible but not probable.

No training or testing activities involving ingestible expended materials are proposed under any alternative in the southeast Alaska portion of the Study Area. Therefore, ingestible military expended materials would have no impact on marine invertebrates under any alternative.

3.8.3.5.1.1 No Action Alternative

Training Activities

Offshore Area

Under the No Action Alternative, a variety of potentially ingestible military expended materials, such as chaff, would be released to the Offshore Area of the Study Area during Navy training activities. The Navy proposes 2,900 training events in which chaff may be expended (see Table 3.0-28). Ingestion is not likely in the majority of cases because most military expended materials, such as sonobuoys, in-water devices, and guidance wires, are too large to be ingested by most marine invertebrates. Chaff has been extensively studied, and no indirect toxic effects are known to occur at realistic concentration in the marine environment (Arfsten et al. 2002). The total number of military expended materials from munitions expended under the No Action Alternative in the Offshore Area is 177,778, and the number of military expended materials other than munitions expended in the Offshore Area is 11,890 (see Table 3.8-2) The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals under the No Action Alternative.

Inland Waters

Under the No Action Alternative, a variety of potentially ingestible military expended materials would be released to the inland water environment by Navy training activities. No chaff canisters would be released during training activities under the No Action Alternative. Ingestion of military expended materials in the inland area, such as sonobuoys, in-water devices, and guidance wires, is not likely as they are too large to be ingested by most marine invertebrates. The total number of military expended munitions expended under the No Action Alternative in the Inland Waters is four, and the number of military expended materials other than munitions expended in the Inland Waters is four (see Table 3.8-2). The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals.

Testing Activities

Offshore Area

Under the No Action Alternative, a variety of potentially ingestible military expended materials would be released to the Offshore Area of the Study Area during Navy testing activities. No chaff canisters would be released during testing activities under the No Action Alternative. Ingestion of military expended materials such as sonobuoys, in-water devices, and guidance wires are not likely as they are too large to be ingested by most marine invertebrates. The total number of military expended munitions expended under the No Action Alternative in the Offshore Area is 200, and the number of military expended materials other than munitions expended in the Offshore Area is 421 (see Table 3.8-2).The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals under the No Action Alternative.

Inland Waters

Under the No Action Alternative, a variety of potentially ingestible military expended materials would be released to the inland water environment by Navy testing activities. No chaff canisters would be released during testing activities under the No Action Alternative. Ingestion of military expended materials such as sonobuoys, in-water devices, and guidance wires is not likely as they are too large to

be ingested by most marine invertebrates. The total number of military expended munitions expended under the No Action Alternative in the Inland Waters is 6, and the number of military expended materials other than munitions expended in the Inland Waters is 440 (see Table 3.8-2). The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals.

3.8.3.5.1.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, a variety of potentially ingestible military expended materials, such as chaff, would be released to the Offshore Area of the Study Area during Navy training activities. Training activities in which chaff may be expended would increase from 2,900 annual activities under the No Action Alternative to 5,000 annual activities under Alternative 1. Despite the increase in chaff-related activities, chaff remains unlikely to result in impacts to marine invertebrates. Chaff has been extensively studied, and no indirect toxic effects are known to occur at realistic concentrations in the marine environment (Arfsten et al. 2002). As with the No Action Alternative, ingestion is not likely because most military expended materials, such as sonobuoys, in-water devices, and guidance wires, are too large to be ingested by most marine invertebrates. The fraction of military expended materials that are of ingestible size, or that become ingestible after degradation, may impact individual marine invertebrates, but are unlikely to have impacts on populations or sub-populations.

Inland Waters

Under Alternative 1, a variety of potentially ingestible military expended materials, such as chaff, would be released to the Inland Waters environment by Navy training activities. No chaff canisters would be released during training activities under Alternative 1. As with the No Action Alternative, ingestion of military expended materials such as sonobuoys, in-water devices, and guidance wires is not likely as they are too large to be ingested by most marine invertebrates. Under Alternative 1 the number of military expended materials from munitions would increase by 4,986 over the No Action Alternative. Military expended materials would increase by 94 (see Table 3.8-2). The fraction of military expended materials that are of ingestible size, or that become ingestible after degradation, may impact individual marine invertebrates, but are unlikely to have impacts on populations or sub-populations.

Testing Activities

Offshore Area

Under Alternative 1, a variety of potentially ingestible military expended materials would be released to the Offshore Area of the Study Area during Navy testing activities. No chaff canisters would be released during testing activities under Alternative 1. Ingestion is not likely in the majority of cases because most military expended materials, such as sonobuoys, in-water devices, and guidance wires, are too large to be ingested by most marine invertebrates. Under Alternative 1 the number of military expended materials from munitions would increase by 1,746 over the No Action Alternative. Military expended materials would increase by 144 (see Table 3.8-2).The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals under Alternative 1.

Inland Waters

Under Alternative 1, a variety of potentially ingestible military expended materials would be released to the Inland Waters environment by Navy testing activities. No chaff canisters would be released during

testing activities under Alternative 1. Ingestion is not likely in the majority of cases because most military expended materials, such as sonobuoys, in-water devices, and guidance wires, are too large to be ingested by most marine invertebrates. Under Alternative 1 the number of military expended materials from munitions remains six, the same as the No Action Alternative. Military expended materials increases by 51 over the No Action Alternative (see Table 3.8-2). The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals.

3.8.3.5.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the Navy proposes the same numbers and types of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on marine invertebrates would be the same as for Alternative 1.

Inland Waters

Under Alternative 2, the Navy proposes the same numbers and types of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on marine invertebrates would be the same as for Alternative 1.

Testing Activities

Offshore Area

Under Alternative 2, a variety of potentially ingestible military expended materials would be released to the marine environment during Navy testing activities. No chaff canisters would be released during testing activities under Alternative 2. Ingestion is not likely in the majority of cases because most military expended materials, such as sonobuoys, in-water devices, and guidance wires, are too large to be ingested by most marine invertebrates. Under Alternative 2, the number of military expended materials from munitions would increase to 2,139 compared to 200 under the No Action Alternative. Military expended materials other than munitions would increase by 204 compared to the No Action Alternative (see Table 3.8-2). The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals.

Inland Waters

Under Alternative 2, a variety of potentially ingestible military expended materials would be released to the Inland Waters environment by Navy testing activities. No chaff canisters would be released during testing activities under the Alternative 2. Ingestion of military expended materials such as sonobuoys, in-water devices, and guidance wires is not likely as they are too large to be ingested by most marine invertebrates. Under Alternative 2 the number of military expended materials from munitions remains six, the same as the No Action Alternative. Military expended materials increases by 122 over the No Action Alternative (see Table 3.8-2). The fractions of military expended materials that are of ingestible size, or become ingestible after degradation, are unlikely to impact individuals.

3.8.3.5.2 Summary of Effects from Ingestion Stressors

Most military expended materials and fragments of military expended materials are too large to be ingested by marine invertebrates. The potential for marine invertebrates to encounter fragments of ingestible size increases as the military expended materials degrade into smaller fragments. The

fractions of military expended materials of ingestible size, or that become ingestible after degradation, may impact individual marine invertebrates, but are unlikely to impact populations.

3.8.3.6 Secondary Stressors

This section analyzes potential impacts on marine invertebrates exposed to stressors indirectly through sediment and water. These two ecosystem constituents, sediment and water, are also primary constituents of marine invertebrate habitat and clear distinctions between indirect impacts and habitat impacts are difficult to maintain. For this analysis, indirect impacts on marine invertebrates via sediment or water that do not require trophic transfers (e.g., bioaccumulation) to be observed are considered here. The terms "indirect" and "secondary" do not imply reduced severity of environmental consequences, but instead describe how the impact may occur in an organism or its ecosystem.

Stressors from Navy training and testing activities could pose secondary or indirect impacts on marine invertebrates via habitat, sediment, or water quality. These include (1) explosives and by-products; (2) metals; (3) chemicals; and (4) other materials such as targets, chaff, and plastics.

3.8.3.6.1 Explosives, Explosion By-Products, and Unexploded Ordnance

High-order explosions consume most of the explosive material, creating typical combustion products. In the case of royal demolition explosive, 98 percent of the combustion products are common seawater constituents, with the remainder rapidly diluted by ocean currents and circulation (see Table 3.1-8 in Section 3.1, Sediments and Water Quality). Explosion by-products from high order detonations present no indirect stressors to marine invertebrates through sediment or water. Low-order detonations and unexploded ordnance present an elevated likelihood of effects on marine invertebrates, and the potential impacts of these on marine invertebrates will be analyzed. Explosive material not completely consumed during a detonation from ordnance disposal and mine clearance training are collected after training is complete; therefore, potential impacts are assumed to be inconsequential and not detectable for these training and testing activities. Marine invertebrates may be exposed by contact with the explosive, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Most marine invertebrates are very small relative to ordnance or fragments, and direct ingestion of unexploded ordnance is unlikely.

Indirect impacts of explosives and unexploded ordnance on marine invertebrates via sediment are possible near the ordnance. Degradation of explosives proceeds via several pathways discussed in Section 3.1.3.1 (Explosives and Explosion By-Products). Degradation products of royal demolition explosive are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo 2010). Trinitrotoluene and its degradation products impact developmental processes in marine invertebrates and are acutely toxic to adults at concentrations similar to real-world exposures (Rosen and Lotufo 2007, 2010). The relatively low solubility of most explosives and their degradation products indicate that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6–12 inches (15–30 centimeters) from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3–6 ft. (1–2 m) from the degrading ordnance (Durrach et al. 1998; Section 3.1.3.1, Explosives and Explosion By-Products). Taken together, marine invertebrates, eggs, and larvae probably would be adversely impacted by the indirect effects of degrading explosives within a very small radius of the explosive (1–6 ft. [0.3–2 m]).

Indirect impacts of explosives and unexploded ordnance on marine invertebrates via water are likely to be inconsequential and not detectable for two reasons. First, most explosives and explosive degradation

products have very low solubility in sea water (see Table 3.1-12 in Section 3.1, Sediments and Water Quality). This means that dissolution occurs extremely slowly, and harmful concentrations of explosives and degradation are not likely to accumulate except within confined spaces. Second, a low concentration of contaminants, slowly delivered into the water column, is readily diluted to non-harmful concentrations. While marine invertebrates may be adversely impacted by the indirect effects of degrading explosives via water (Rosen and Lotufo 2007a, 2010), this is extremely unlikely in realistic scenarios.

Impacts on marine invertebrates, including zooplankton, eggs, and larvae, are likely to occur within a very small radius of the ordnance (1–6 ft. [0.3–2 m]). These impacts may continue as the ordnance degrades over months to decades. Because most ordnance is deployed as projectiles, multiple unexploded or low-order detonations would not accumulate on spatial scales of 1 to 6 ft. (0.3 to 2 m); therefore, potential impacts are likely to remain local and widely separated. Given these conditions, the possibility of population-level impacts on marine invertebrates is inconsequential.

3.8.3.6.2 Metals

Certain metals are harmful to marine invertebrates at concentrations above background levels (e.g., cadmium, chromium, lead, mercury, zinc, copper, manganese, and many others) (Negri et al. 2002; Wang and Rainbow 2008). Metals are introduced into seawater and sediments as a result of training and testing activities involving vessel hulks, targets, ordnance, munitions, and other military expended materials (see Section 3.1.3.2, Metals). Many metals bioaccumulate and physiological impacts begin to occur only after several trophic transfers concentrate the toxic metals. Indirect impacts of metals on marine invertebrates via sediment and water involve concentrations several orders of magnitude lower than concentrations achieved via bioaccumulation. Marine invertebrates may be exposed by contact with the metal, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Most marine invertebrates are very small relative to Navy military expended materials, and ingestion would be unlikely.

Because metals often concentrate in sediments, potential adverse indirect impacts are much more likely via sediment than via water. Despite the acute toxicity of some metals (e.g., hexavalent chromium or tributyltin) (Negri et al. 2002) concentrations above safe limits are rarely encountered even in live-fire areas of Vieques where deposition of metals from Navy activities is very high (see Section 3.1.3.2, Metals. Other studies described in Section 3.1.3.2 (Metals) find no harmful concentrations of metals from deposition of military metals into the marine environment. Marine invertebrates, eggs, or larvae could be indirectly impacted by metals via sediment within a few inches of the object.

Concentrations of metals in seawater are orders of magnitude lower than concentrations in marine sediments. Marine invertebrates probably would not be indirectly impacted by toxic metals via the water, or via sediment near the object (e.g., within a few inches) because such impacts would be local and widely separated. Concentrations of metals in water are not likely to be high enough to cause injury or mortality to marine invertebrates. Therefore, indirect impacts of metals via water are likely to be inconsequential and not detectable. Given these conditions, population-level impacts on marine invertebrates are likely to be inconsequential and not detectable.

3.8.3.6.3 Chemicals

Several Navy training and testing activities introduce potentially harmful chemicals into the marine environment; principally, flares and propellants from rockets, missiles, and torpedoes. Properly functioning flares, missiles, rockets, and torpedoes combust most of their propellants, leaving benign or

readily diluted soluble combustion by-products (e.g., hydrogen cyanide). Operational failures allow propellants and their degradation products to be released into the marine environment. The greatest risk to marine invertebrates from flares, missiles, and rocket propellants is perchlorate, which is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals. Torpedo propellant poses little risk to marine invertebrates because the chemicals have relatively low toxicity (see Section 3.1.3.3). Marine invertebrates may be exposed by contact with the chemical, contact with chemical contaminants in the sediment or water, and ingestion of contaminated sediments. Most marine invertebrates are very small relative to Navy military expended materials or fragments of military expended materials, and ingestion of military expended materials would be unlikely.

Therefore, missile and rocket fuel poses inconsequential risks of indirect impacts on marine invertebrates via sediment. In contrast, the principal toxic components of torpedo fuel, propylene glycol dinitrate and nitrodiphenylamine, adsorb to sediments, have relatively low toxicity, and are readily degraded by biological processes (Section 3.1.3.3, Chemicals Other than Explosives). Marine invertebrates, eggs, or larvae could be indirectly impacted by propellants via sediment near the object (e.g., within a few inches), but these potential impacts would diminish rapidly as the propellant degrades (see discussion in Section 3.1.3.3, Chemicals Other than Explosives).

Perchlorate contamination rapidly disperses throughout the water column and water within sediments. While it impacts biological processes at low concentrations (e.g., less than 10 parts per billion), toxic concentrations are unlikely to be encountered in seawater. The principal mode of perchlorate toxicity in the environment is bioaccumulation.

Torpedo propellants have relatively low toxicity and therefore pose an inconsequential risk to marine invertebrates. Marine invertebrates, zooplankton, eggs, or larvae could be indirectly impacted by hydrogen cyanide produced by torpedo fuel combustion, but these impacts would diminish rapidly as the chemical becomes diluted below toxic levels. Chemicals are rapidly diluted and readily biodegraded, and concentrations high enough to be acutely toxic are unlikely in the marine environment (see Section 3.1.3.3, Chemicals Other than Explosives, for a discussion of these mechanisms). Concentrations of chemicals in sediment and water are not likely to cause injury or mortality to marine invertebrates; therefore; indirect impacts of chemicals via sediment and water are likely to be inconsequential and not detectable. Based on negligible impacts on individuals, population-level impacts on marine invertebrates are likely to be inconsequential and not detectable.

In the past, polychlorinated biphenyls (PCBs) were a concern because they were present in certain materials (e.g., insulation, sires, felts, and gaskets) on vessels used as targets during sinking exercises. PCBs have a variety of deleterious effects on marine organisms. Polychlorinated biphenyls persist in the tissues of organisms at the bottom of the food chain. Consumers of those species may accumulate PCBs at concentrations many times higher than the PCB concentration in the surrounding water or sediments. Vessels now used for sinking exercises are selected from a list of U.S. Navy-approved vessels that were cleaned in accordance with U.S. Environmental Protection Agency guidelines, but may contain PCBs that could not be removed during cleaning.

3.8.3.6.4 Other Materials

Military expended materials that are re-mobilized after their initial contact with the seafloor (e.g., by waves or currents) may continue to strike or abrade marine invertebrates. Secondary physical strike and disturbances are relatively unlikely because most expended materials are more dense than the surrounding sediments (i.e., metal), and are likely to remain in place as the surrounding sediment

moves. The principal exception is likely to be parachutes, which are moved easily relative to projectiles and fragments. Potential secondary physical strike and disturbance impacts may cease only (1) when the military expended materials is too massive to be mobilized by typical oceanographic processes, (2) when the military expended material becomes encrusted by natural processes and incorporated into the seafloor, or (3) when the military expended materials becomes permanently buried. The fitness of individual organisms would be impacted directly or indirectly, but not to the extent that the viability of populations or species would be impacted.

All military expended material, including targets and vessel hulks used for sinking exercises that contain materials other than metals, explosives, or chemicals, is evaluated for potential indirect impacts on marine invertebrates via sediment and water. Principal components of these military expended materials include: aluminized fiberglass (chaff); carbon or Kevlar fiber (missiles); and plastics (canisters, targets, sonobuoy components, parachutes, etc). Potential effects of these materials are discussed in Section 3.1.3.4 (Other Materials). Chaff has been extensively studied, and no indirect toxic effects are known to occur at realistic concentrations in the marine environment (Arfsten et al. 2002). Plastics contain chemicals, including persistent organic pollutants, which could indirectly affect marine invertebrates (Derraik 2002; Mato et al. 2001; Teuten et al. 2007). Marine invertebrates may be exposed by contact with the plastic, contact with associated plastic chemical contaminants in the sediment or water, or ingestion of contaminated sediments. Most marine invertebrates are very small relative to Navy military expended materials or fragments of military expended materials, and direct ingestion of military expended materials is unlikely.

The only material that could impact marine invertebrates via sediment is plastics. Harmful chemicals in plastics interfere with metabolic and endocrine processes in many plants and animals (Derraik 2002). Potentially harmful chemicals in plastics are not readily adsorbed to marine sediments; instead, marine invertebrates are most at risk via ingestion or bioaccumulation (see Sections 3.8.3.5, Ingestion Stressors, and 3.3, Marine Habitats). Because plastics retain much of their chemical properties as they are physically degraded into microplastic particles (Singh and Sharma 2008), the exposure risks to marine invertebrates are dispersed over time. Marine invertebrates could be indirectly impacted by chemicals from plastics expended during training and testing activities but these effects would be limited to direct contact with the material. Because of these conditions, population-level impacts on marine invertebrates are likely to be inconsequential and not detectable.

3.8.3.6.5 Substressor Impact on Sedentary Invertebrate Beds and Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of metal, chemical, and other material contaminants, and secondary physical disturbances during training and testing activities, would have no adverse effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The use of explosives, explosive byproducts, and unexploded ordnance during training and testing activities may have an adverse effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The EFHA states that substressor impacts on invertebrate beds or reefs would be minimal and short-term within the Study Area.

3.8.4 SUMMARY OF POTENTIAL IMPACTS (COMBINED IMPACTS OF ALL STRESSORS) ON MARINE INVERTEBRATES

3.8.4.1 Combined Impacts of All Stressors

As described in Section 3.0.5.5 (Resource-Specific Impacts Analysis for Multiple Stressors), this section evaluates the potential for combined impacts of all the stressors from the proposed action. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in the sections above. Stressors associated with Navy training and testing activities do not typically occur in isolation but rather occur in some combination. For example, mine neutralization activities include elements of acoustic, physical disturbance and strike, entanglement, ingestion, and secondary stressors that are all coincident in space and time. An analysis of the combined impacts of all stressors considers the potential consequences of aggregate exposure to all stressors and the repetitive or additive consequences of exposure over multiple years. This analysis makes the reasonable assumption that the majority of exposures to stressors are non-lethal, and instead focuses on consequences potentially impacting the organism's fitness (e.g., physiology, behavior, and reproductive potential).

It is unlikely that mobile or migratory marine invertebrates that occur within the water column would be exposed to multiple activities during their lifespan because they are relatively short lived, and most Navy training and testing activities impact small, widely-dispersed areas. It is much more likely that stationary organisms or those that only move over a small range (e.g., corals, worms, and sea urchins) would be exposed to multiple activities because many Navy activities occur in the same location (e.g., gunnery and mine warfare).

Multiple stressors can co-occur with marine invertebrates in two general ways. The first would be if a marine invertebrate were exposed to multiple sources of stress from a single event or activity. The second is exposure to a combination of stressors over the course of the organism's life. Both general scenarios are more likely to occur in locations where training and testing activities are concentrated. The key difference between the two scenarios is the amount of time between exposures to stressors. Time is an important factor because some stressors develop over a long period, while others occur and pass quickly (e.g., dissolution of secondary stressors into the sediment versus physical disturbance). Similarly, time is an important factor for the organism because subsequent disturbances or injuries often increase the time needed for the organism to recover to baseline behavior/physiology, extending the time that the organism's fitness is impacted.

Marine invertebrates are susceptible to multiple stressors (see Section 3.8.2.3, General Threats), and susceptibilities of many species are enhanced by additive or synergistic effects of multiple stressors. The global decline of corals, for example, is driven primarily by synergistic impacts of pollution, ecological consequences of overfishing, and climate change. As discussed in the analyses above, marine invertebrates are not particularly susceptible to energy, entanglement, or ingestion stressors resulting from Navy activities (see Section 3.8.3.2, Energy Stressors; Section 3.8.3.4, Entanglement Stressors; and Section 3.8.3.5, Ingestion Stressors); therefore, the opportunity for Navy stressors to result in additive or synergistic consequences is most likely limited to acoustic, physical strike and disturbance, and secondary stressors.

Despite uncertainty in the nature of consequences resulting from combined impacts, the location of potential combined impacts can be predicted with more certainty because combinations are much more likely in locations where training and testing activities are concentrated. However, analyses of the nature of potential consequences of combined impacts of all stressors on marine invertebrates remain largely qualitative and speculative. Where multiple stressors coincide with marine invertebrates, the

likelihood of a negative consequence is elevated, but it is not feasible to predict the nature of the consequence or its likelihood because not enough is known about potential additive or synergistic interactions. Even for shallow-water coral reefs, an exceptionally well-studied resource, predictions of the consequences of multiple stressors are semi-quantitative and generalized predictions remain qualitative (Hughes and Connell 1999; Jackson 2008; Norström et al. 2009). It is also possible that Navy stressors will combine with non-Navy stressors, and this is qualitatively discussed in Chapter 4 (Cumulative Impacts).

3.8.4.2 Essential Fish Habitat Determinations

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other acoustic sources; vessel noise; weapons firing noise; vessel movement; in-water devices; and metal, chemical, or other material contaminants would have no adverse effect on sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The use of explosives, electromagnetic sources, military expended materials, seafloor devices, and explosives and explosive byproduct contaminants may have an adverse effect on EFH by reducing the quality and quantity of sedentary invertebrate beds or reefs that constitute EFH or Habitat Areas of Particular Concern. The EFHA states that individual stressor impacts were all either no effect, or minimal and ranged in duration from temporary to permanent, depending on the stressor.

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3.9 Fish

TABLE OF CONTENTS

3.9 FISH 3.9-1
3.9.1 INTRODUCTION AND METHODS 3.9-2
3.9.1.1 Endangered Species Act Species 3.9-3
3.9.1.2 Taxonomic Groups 3.9-7
3.9.2 AFFECTED ENVIRONMENT 3.9-8
3.9.2.1 Hearing and Vocalization 3.9-8
3.9.2.2 General Threats 3.9-11
3.9.2.3 Endangered Species Act-Listed Species 3.9-12
3.9.2.4 Federally Managed Fisheries 3.9-41
3.9.2.5 Taxonomic Group Descriptions and Distribution 3.9-41
3.9.3 ENVIRONMENTAL CONSEQUENCES 3.9-57
3.9.3.1 Acoustic Stressors 3.9-58
3.9.3.2 Energy Stressors 3.9-88
3.9.3.3 Physical Disturbance and Strike Stressors 3.9-93
3.9.3.4 Entanglement Stressors 3.9-121
3.9.3.5 Ingestion Stressors 3.9-137
3.9.3.6 Secondary Stressors 3.9-151
3.9.4 SUMMARY OF POTENTIAL IMPACTS ON FISH 3.9-154
3.9.4.1 Combined Impacts of All Stressors 3.9-154
3.9.4.2 Endangered Species Act Determinations 3.9-155

LIST OF TABLES

TABLE 3.9-1: STATUS AND PRESENCE OF ENDANGERED SPECIES ACT-LISTED FISH SPECIES, CANDIDATE SPECIES, AND SPECIES OF CONCERN FOUND IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-4
TABLE 3.9-2: MAJOR TAXONOMIC GROUPS OF MARINE FISHES WITHIN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-7
TABLE 3.9-3: FEDERALLY MANAGED FISH SPECIES WITHIN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-42
TABLE 3.9-4: STRESSORS FOR FISH IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-59
TABLE 3.9-5: ESTIMATED EXPLOSIVE EFFECTS RANGES FOR FISH WITH SWIM BLADDERS 3.9-81
TABLE 3.9-6: SUMMARY OF INGESTION STRESSORS ON FISHES BASED ON LOCATION 3.9-139
TABLE 3.9-7: SUMMARY OF ENDANGERED SPECIES ACT DETERMINATIONS FOR TRAINING AND TESTING ACTIVITIES FOR THE PREFERRED ALTERNATIVE (ALTERNATIVE 1) 3.9-156

LIST OF FIGURES

FIGURE 3.9-1: CHINOOK SALMON CRITICAL HABITAT IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-15
FIGURE 3.9-2: CHUM SALMON CRITICAL HABITAT IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-22
FIGURE 3.9-3: BULL TROUT CRITICAL HABITAT IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-31
FIGURE 3.9-4: GREEN STURGEON CRITICAL HABITAT IN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.9-40

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3.9 FISH

FISH SYNOPSIS

The United States Department of the Navy considered all potential stressors and the following have been analyzed for fish:

- Acoustic (sonar and other active acoustic sources; underwater explosives; weapons firing, launch, and impact noise; vessel noise; and aircraft noise)
- Energy (electromagnetic devices)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, and seafloor devices)
- Entanglement (fiber optic cables, guidance wires, and decelerator/parachutes)
- Ingestion (munitions and military expended material other than munitions)
- Secondary (indirect impacts associated with habitat quality)

Preferred Alternative (Alternative 1)

- Acoustics: Pursuant to the Endangered Species Act (ESA), the use of sonar and other non-impulse sources during training and testing activities may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species; and would have no effect on any species' critical habitat. The use of explosives and other impulse sources during training and testing activities may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species; may affect, but is not likely to adversely affect, critical habitat for salmonid species and green sturgeon; and would have no effect on Pacific eulachon critical habitat.
- Energy: Pursuant to the ESA, the use of electromagnetic devices during training activities may affect but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species; may affect, but is not likely to adversely affect, salmonid critical habitat; and would have no effect on critical habitat for Pacific eulachon and green sturgeon.
- Physical Disturbance and Strike: Pursuant to the ESA, the use of vessels and in-water devices may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, and Pacific eulachon species; would have no effect on rockfish species; may affect, but is not likely to adversely affect, salmonid critical habitat; and would have no effect on Pacific eulachon and green sturgeon critical habitat. The use of military expended materials would have no effect on Pacific eulachon and their associated critical habit; may affect, but is not likely to adversely affect, ESA-listed salmonid species, rockfish species, and green sturgeon; and may affect but is not likely to adversely affect salmonid and green sturgeon critical habitat. The use of seafloor devices may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species; and may affect but is not likely to adversely affect salmonid and green sturgeon critical habitat.

FISH SYNOPSIS (continued)

- Entanglement: Pursuant to the ESA, the use of fiber optic cables, guidance wires, and decelerator/parachutes during training and testing activities may affect but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species; would have no effect on Pacific eulachon critical habitat; and may affect but is not likely to adversely affect, salmonid critical habitat. The use of fiber optic cables and guidance wires would have no effect on green sturgeon critical habitat. The use of decelerator/parachutes may affect, but is not likely to adversely affect, green sturgeon critical habitat.
- Ingestion: Pursuant to the ESA, the use of munitions and military expended material other than munitions may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species. Ingestion sources may affect, but are not likely to adversely affect, salmonid and green sturgeon critical habitat; and would have no effect on Pacific eulachon critical habitat.
- Secondary Stressors: Pursuant to the ESA, secondary stressors from training and testing activities would have no effect on ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species; and would have no effect on salmonid, Pacific eulachon, and green sturgeon critical habitat.

3.9.1 Introduction and Methods

This section analyzes the potential impacts of the Proposed Action on fishes found in the Northwest Training and Testing (NWTT) Study Area (Study Area). Section 3.9 provides a synopsis of the United States (U.S.) Department of the Navy's (Navy's) determinations of the impacts of the Proposed Action on fish. Section 3.9.1 (Introduction) introduces the species and taxonomic groups that occur in the Study Area. Section 3.9.2 (Affected Environment) discusses the baseline affected environment. The complete analysis of environmental consequences is in Section 3.9.3 (Environmental Consequences), and the potential impacts of the Proposed Action on fishes are summarized in Section 3.9.4 (Summary of Potential Impacts on Fish).

For this Environmental Impact Statement (EIS), marine fishes are evaluated as groups of species characterized by distribution, body type, or behavior relevant to the stressor being evaluated. Activities are evaluated for their potential impact on all fishes in general, by taxonomic groupings, and the 11 marine fish in the Study Area listed under the Endangered Species Act (ESA).

Fish species listed under the ESA, along with major taxonomic groups in the Study Area, are described in this section. Marine fish species that are regulated under the Magnuson-Stevens Fishery Conservation and Management Act are discussed in Section 3.9.2.4 (Federally Managed Fisheries). Additional general information on the biology, life history, distribution, and conservation of marine fishes can be found on the websites of the following agencies and organizations, as well as many others:

- National Marine Fisheries Service (NMFS), Office of Protected Resources (including ESA-listed species distribution maps)
- Regional Fishery Management Councils
- International Union for Conservation of Nature
- Essential Fish Habitat Text Descriptions

Fishes are not distributed uniformly throughout the Study Area but are closely associated with a variety of habitats. Some species, such as large sharks, tuna, and billfishes range across thousands of square miles (thousands of square kilometers); others, such as gobies and reef fishes have small home ranges and restricted distributions (Helfman et al. 2009a). The movements of some open-ocean species may never overlap with coastal fishes that spend their lives within several hundred feet (a few hundred meters) of the shore. Even within a single fish species, the distribution and specific habitats in which individuals occur may be influenced by its developmental stage, size, sex, reproductive condition, and other factors.

3.9.1.1 Endangered Species Act Species

There are 34 fish species that are listed as either threatened or endangered under the ESA (Table 3.9-1 and Section 3.9.2.3) that occur in the Study Area. The ESA defines a "species" to include any distinct population segment (DPS) of any species of vertebrate fish or wildlife. For Pacific salmon, NMFS considers an evolutionarily significant unit (ESU) a "species" under the ESA (National Marine Fisheries Service 2007). For Pacific steelhead, rockfish, eulachon, and green sturgeon, NMFS has delineated DPSs as a "species" under the ESA (National Marine Fisheries Service 2007). NMFS has listed 28 species of salmon and steelhead on the West Coast, which overlap with the Study Area. In addition, the U.S. Fish and Wildlife Service has listed bull trout throughout its range, which overlaps with the Study Area. Finally, three rockfish species, the Pacific eulachon, and the green sturgeon are also listed and overlap with the Study Area. Two species are candidates for listing as threatened or endangered and there are seven species of concern, defined as a species about which NMFS has some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA. The emphasis on species-specific information in the following profiles will be on the ESA protected species because any threats or potential impacts on those species are subject to consultation with regulatory agencies.

Table 3.9-1: Status and Presence of Endangered Species Act-Listed Fish Species, Candidate Species, and Species of Concern Found in the Northwest Training and Testing Study Area

Species Name and Regulatory Status				Presence in Study Area		
Common Name (Scientific Name)	**Distinct Population Segment (DPS)[1]/ Evolutionarily Significant Unit (ESU)[2]**	**Federal Status**	**Critical Habitat Designation**	**Offshore Area**	**Inland Waters**	**Western Behm Canal, Alaska**
Salmonid Species						
Chinook salmon (*Oncorhynchus tshawytscha*)	Puget Sound ESU	T	Designated (Inland Waters)		✓	
	Upper Columbia River spring-run ESU	E	Designated (not in Study Area)	✓		
	Lower Columbia River ESU	T	Designated (not in Study Area)	✓		
	Upper Willamette River ESU	T	Designated (not in Study Area)	✓		
	Snake River spring/summer-run ESU	T	Designated (not in Study Area)	✓		
	Snake River fall-run ESU	T	Designated (not in Study Area)	✓		
	California Coastal ESU	T	Designated (not in Study Area)	✓		
	Upper Klamath and Trinity Rivers Basin ESU	CS	Not Designated	✓		
	Central Valley, fall and late fall run ESU	SOC	Designated (not in Study Area)	✓		
	Central Valley spring-run ESU	T	Designated (not in Study Area)	✓		
	Sacramento River winter-run	E	Designated (not in Study Area)	✓		
Coho salmon (*Oncorhynchus kisutch*)	Lower Columbia ESU	T	Proposed	✓		
	Oregon coast ESU	T	Designated (not in Study Area)	✓		
	Southern Oregon/Northern California coast ESU	T	Designated (not in Study Area)	✓		
	Puget Sound/Strait of Georgia ESU	SOC	Not Designated		✓	
	Central California Coast	E	Designated (not in Study Area)	✓		

Table 3.9-1: Status and Presence of Endangered Species Act-Listed Fish Species, Candidate Species, and Species of Concern Found in the Northwest Training and Testing Study Area (continued)

Species Name and Regulatory Status				Presence in Study Area		
Common Name (Scientific Name)	**Distinct Population Segment (DPS)[1]/ Evolutionarily Significant Unit (ESU)[2]**	**Federal Status**	**Critical Habitat Designation**	**Offshore Area**	**Inland Waters**	**Western Behm Canal, Alaska**
Salmonid Species (continued)						
Chum Salmon (*Oncorhynchus keta*)	Hood Canal summer-run ESU	T	Designated (Inland Waters)		✓	
	Columbia River ESU	T	Designated (not in Study Area)	✓		
Sockeye salmon (*Oncorhynchus nerka*)	Ozette Lake ESU	T	Designated (not in Study Area)	✓		
	Snake River ESU	E	Designated (not in Study Area)	✓		
Steelhead (*Oncorhynchus mykiss*)	Puget Sound DPS	T	Proposed		✓	
	Upper Columbia River DPS	T	Designated (not in Study Area)	✓		
	Middle Columbia River DPS	T	Designated (not in Study Area)	✓		
	Lower Columbia River DPS	T	Designated (not in Study Area)	✓		
	Upper Willamette River DPS	T	Designated (not in Study Area)	✓		
	Snake River Basin DPS	T	Designated (not in Study Area)	✓		
	Northern California DPS	T	Designated (not in Study Area)	✓		
	Oregon Coast DPS	SOC	Not Designated	✓		
	California Central Valley DPS	T	Designated (not in Study Area)	✓		
	Central California Coast DPS	T	Designated (not in Study Area)	✓		
	South-Central California Coast DPS	T	Designated (not in Study Area)	✓		
	Southern California DPS	E	Designated (not in Study Area)	✓		

Table 3.9-1: Status and Presence of Endangered Species Act-Listed Fish Species, Candidate Species, and Species of Concern Found in the Northwest Training and Testing Study Area (continued)

Species Name and Regulatory Status				Presence in Study Area		
Common Name (Scientific Name)	**Distinct Population Segment (DPS)[1]/ Evolutionarily Significant Unit (ESU)[2]**	**Federal Status**	**Critical Habitat Designation**	**Offshore Area**	**Inland Waters**	**Western Behm Canal, Alaska**
Salmonid Species (continued)						
Bull trout (*Salvenlinus confluentus*)	Coastal Puget Sound DPS	T	Designated (Offshore and Inland Waters)	✓	✓	
Rockfish Species						
Bocaccio (*Sebastes paucispinis*)	Puget Sound/Georgia Basin DPS	E	Proposed		✓	
	Southern DPS (Northern California to Mexico)	SOC	Not Designated	✓		
Canary rockfish (*Sebastidae pinniger*)	Puget Sound/Georgia Basin DPS	T	Proposed		✓	
Yelloweye rockfish (*Sebastes ruberrimus*)	Puget Sound/Georgia Basin DPS	T	Proposed		✓	
Pacific Eulachon (*Thaleichthys pacificus*)	Southern DPS	T	Designated (not in Study Area)	✓	✓	
Green Sturgeon (*Acipenser medirostris*)	Southern DPS	T	Designated (Offshore and Inland Waters)	✓	✓	
	Pacific-northern DPS	SOC	Not Designated	✓	✓	
Other Marine Fish Species of Concern						
Cowcod (*Sebastes levis*)	Central Oregon to central Baja California and Guadalupe Island, Mexico ESU	SOC	Not Designated	✓		
Pacific Hake (*Merluccius productus*)	Georgia Basin (Canada to Washington State) DPS	SOC	Not Designated		✓	
Basking shark (*Cetorhinus maximus*)	Eastern North Pacific DPS	SOC	Not Designated	✓		
Pacific Herring (*Clupea pallasii*)	Southeast Alaska DPS	CS	Not Designated			✓

[1] A species with more than one distinct population segment can have more than one ESA listing status, as individual distinct population segments can be either not listed under the ESA or can be listed as endangered, threatened, or a candidate species.
[2] Evolutionarily significant unit is a population of organisms that is considered distinct for purposes of conservation.
[3] Federal Status: E = Endangered, T = Threatened, CS = Candidate Species, SOC = Species of Concern

3.9.1.2 Taxonomic Groups

Taxonomic groupings of marine fishes are listed in Table 3.9-2 and are described further in Section 3.9.2 (Affected Environment). To ensure inclusion of all marine fishes representative of the Study Area, these taxonomic groups are presented to supplement the approach used for the ESA-protected species in this document.

Table 3.9-2: Major Taxonomic Groups of Marine Fishes within the Northwest Training and Testing Study Area

Major Taxonomic Groups[1]		Vertical Distribution Within Study Area		
Common Name (Taxonomic Group)	**Description**	**Offshore Area**	**Inland Waters**	**Southeast Alaska**
Jawless fishes (order Myxiniformes and order Petromyzontiformes)	Primitive fishes with an eel-like body shape that feed on dead fishes or are parasitic on other fishes	Water column, seafloor	Seafloor	Seafloor
Sharks, rays, and chimaeras (class Chondrichthyes)	Cartilaginous (non-bony) fishes, many of which are open ocean predators	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor
Eels and spiny eels (order Anguilliformes, order Elopiformes)	Undergo a unique larval stage with a small head and elongated body; very different from other fishes	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor
Eulachon and salmonids (orders Argentiniformes, Osmeriformes, Esociformes, and Salmoniformes)	Most salmon and eulachon are migratory between marine and estuarine/freshwater habitats; Argentiniformes occur in deep waters	Seafloor (Argentiniformes only), surface, water column	Surface, water column	Surface, water column
Dragonfishes and lanternfishes (orders Stomiiformes and Myctophiformes)	Largest group of deepwater fishes, most possess adaptations for low-light conditions	Water column, seafloor	Water column, seafloor	Water column, seafloor
Greeneyes, lizardfishes, lancetfishes, and telescopefishes (order Aulopiformes)	Possess both primitive and advanced features of marine fishes	Seafloor	Water column, seafloor	Water column, seafloor
Cods and cusk eels (orders Gadiformes and Ophidiiformes)	Important commercial fishery resources (cods), associated with bottom habitats, also includes some deepwater groups	Water column, seafloor	Water column, seafloor	Water column, seafloor
Toadfishes and anglerfishes (orders Batrachoidiformes and Lophiiformes)	Includes the toadfishes and the anglerfishes, a lie-in-wait predator	Seafloor	Seafloor	Seafloor
Silversides and flying fish (orders Atheriniformes and Beloniformes)	Small-sized nearshore/coastal fishes, primarily feed on organic debris; also includes the surface-oriented flyingfishes	Surface	Surface, water column, seafloor	Surface, water column, seafloor
Oarfishes, squirrelfishes, and dories (orders Lampridiformes, Beryciformes, Zeiformes)	Primarily open ocean or deepwater fishes, except for squirrelfishes (reef-associated)	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor

Table 3.9-2: Major Taxonomic Groups of Marine Fishes within the Northwest Training and Testing Study Area (continued)

Major Taxonomic Groups[1]		Vertical Distribution Within Study Area		
Common Name (Taxonomic Group)	**Description**	**Offshore Area**	**Inland Waters**	**Southeast Alaska**
Pipefishes and seahorses (order Gasterosteiformes)	Small mouth with tubular snout and armor like scales; gives birth to live young and shows a high level of parental care	None	Surface, water column, seafloor	Surface, water column, seafloor
Scorpionfishes (order Scorpaeniformes)	Bottom dwelling with modified pectoral fins to rest on the bottom	Seafloor	Seafloor	Surface, water column, seafloor
Groupers and seabasses (family Serranidae)	Important game fishes with vulnerable conservation status; some have a hermaphroditic strategy in which females become males as they mature	Water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor
Gobies and blennies (families Gobiidae and Blennidae)	Gobies are the largest and most diverse family of marine fishes, mostly found in bottom habitats of coastal areas	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor
Jacks, tunas, mackerels, and billfishes (families Carangidae, Scombridae, Xiphiidae, Istiophoridae)	Highly migratory predators found near the surface; they make up a major component of fisheries	Surface	Surface, water column	Surface, water column
Flounders (order Pleuronectiformes)	Flatfishes that occur in bottom habitats throughout the world where they are well camouflaged	Seafloor	Seafloor	Seafloor
Ocean sunfish (molas) (order Tetraodontiformes)	Unique body shapes and characteristics to avoid predators (e.g., spines); includes ocean sunfish, the largest bony fish	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor

[1] Taxonomic groups are based on the following commonly accepted references: Helfman et al. 1997; Moyle and Cech 1996; Nelson 2006.

3.9.2 AFFECTED ENVIRONMENT

The distribution and abundance of fishes depends greatly on the physical and biological factors of the marine ecosystem, such as salinity, temperature, dissolved oxygen, population dynamics, predator and prey interaction oscillations, seasonal movements, reproduction and life cycles, and recruitment success (Helfman et al. 1997). A single factor is rarely responsible for the distribution of fish species; more often, a combination of factors is accountable. For example, open ocean species optimize their growth, reproduction, and survival by tracking gradients of temperature, oxygen, or salinity (Helfman et al. 1997). Another major component in understanding species distribution is the location of highly productive regions, such as frontal zones. These areas concentrate various prey species and their predators, such as tuna, and provide visual cues for the location of target species for commercial fisheries (National Marine Fisheries Service 2001).

3.9.2.1 Hearing and Vocalization

All fish have two sensory systems to detect sound in the water: the inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper 2008). The inner ear generally detects relatively higher-frequency sounds, while

the lateral line detects water motion at low frequencies (below a few hundred Hertz [Hz]) (Hastings and Popper 2005).

Many researchers have investigated hearing and vocalizations in fish species (e.g., Astrup 1999; Astrup and Mohl 1993; Casper et al. 2003a; Casper and Mann 2006a; Coombs and Popper 1979a; Dunning et al. 1992; Egner and Mann 2005a; Gregory and Clabburn 2003; Hawkins and Johnstone 1978a; Higgs et al. 2004; Iversen 1967, 1969; Jorgensen et al. 2005; Kenyon 1996a; Mann et al. 2001; Mann et al. 2005a; Mann and Lobel 1997; Meyer et al. 2010; Myrberg 2001; Nestler et al. 2002; Popper 2008; Popper and Carlson 1998; Popper and Tavolga 1981; Ramcharitar et al. 2006a; Ramcharitar et al. 2001; Ramcharitar and Popper 2004a; Ramcharitar and Popper 2004b; Remage-Healey et al. 2006b; Ross et al. 1996; Sisneros and Bass 2003b; Song et al. 2006; Wright et al. 2007; Wright et al. 2005). Although hearing capability data only exist for fewer than 100 of the 32,000 fish species, current data suggest that most species of fish detect sounds from 50 to 1,000 Hz, with few fish hearing sounds above 4 kilohertz (kHz) (Popper and Hastings 2009a; Popper 2008). It is believed that most fish have their best hearing sensitivity from 100 to 400 Hz (Popper 2003b). Additionally, some clupeids (shad in the subfamily Alosinae) possess ultrasonic hearing (i.e., able to detect sounds above 100,000 Hz) (Astrup 1999).

The inner ears of fish are directly sensitive to acoustic particle motion rather than acoustic pressure (for a more detailed discussion of particle motion versus pressure, see Section 3.0.4, Introduction to Acoustics). Although a propagating sound wave contains pressure and particle motion components, particle motion is most significant at low frequencies (less than a few hundred Hz) and closer to the sound source. However, a fish's gas-filled swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear. Fish with swim bladders generally have better sensitivity and better high-frequency hearing than fish without swim bladders (Popper and Fay 2010). Some fish also have specialized structures such as small gas bubbles or gas-filled projections that terminate near the inner ear. In reality many fish species possess a continuum of anatomical specializations that may enhance their sensitivity to pressure (versus particle motion), and thus higher frequencies and lower intensities (Popper and Fay 2010).

Past studies indicated that hearing specializations in marine fish were quite rare (Amoser and Ladich 2005; Popper 2003b). However, more recent studies have shown that there are more fish species than originally investigated by researchers, such as deep sea fish, that may have evolved structural adaptations to enhance hearing capabilities (Buran et al. 2005; Deng et al. 2011). Marine fish families Holocentridae (squirrelfish and soldierfish), Pomacentridae (damselfish), Gadidae (cod, hakes, and grenadiers), and Sciaenidae (drums, weakfish, and croakers) have some members that can potentially hear sound up to a few kHz. There is also evidence, based on the structure of the ear and the relationship between the ear and the swim bladder, that at least some deep-sea species, including myctophids, may have hearing specializations and thus be able to hear higher frequencies (Deng et al. 2011; Popper 1977; Popper 1980), although it has not been possible to do actual measures of hearing on these fish from great depths.

Several species of reef fish tested have shown sensitivity to higher frequencies (i.e., over 1,000 Hz). The hearing of the shoulderbar soldierfish (*Myripristis kuntee*) has a higher-frequency auditory range extending toward 3 kHz (Coombs and Popper 1979b), while other species tested in this family have been demonstrated to lack this high frequency hearing ability (e.g., Hawaiian squirrelfish [*Adioryx xantherythrus*] and saber squirrelfish [*Sargocentron spiniferum*]). Some damselfish can hear frequencies of up to 2 kHz, but with best sensitivity well below 1 kHz (Egner and Mann 2005b; Kenyon 1996b; Wright et al. 2005; Wright et al. 2007).

Sciaenid research by Ramcharitar et al. (2006b) investigated the hearing sensitivity of weakfish (*Cynoscion regalis*). Weakfish were found to detect frequencies up to 2 kHz. The sciaenid with the greatest hearing sensitivity discovered thus far is the silver perch (*Bairdiella chrysoura*), which has responded to sounds up to 4 kHz (Ramcharitar et al. 2004). Other species tested in the family Sciaenidae have been demonstrated to lack this higher frequency sensitivity.

It is possible that the Atlantic cod (*Gadus morhua,* Family: Gadidae) is also able to detect high-frequency sounds (Astrup and Mohl 1993). However, in Astrup and Mohl's (1993) study it is feasible that the cod was detecting the stimulus using touch receptors that were over driven by very intense fish-finding sonar emissions (Astrup 1999, Ladich and Popper 2004). Nevertheless, Astrup and Mohl (1993) indicated that cod have high frequency thresholds of up to 38 kHz at 185 to 200 decibels (dB) relative to (re) 1 micropascal (µPa), which likely only allows for detection of odontocete's clicks at distances no greater than 33 to 98 feet (ft.) (10.1 to 29.9 meters [m]) (Astrup 1999). Experiments on several species of the Clupeidae (i.e., herrings, shads, and menhadens) have obtained responses to frequencies between 40 kHz and 180 kHz (Astrup 1999); however, not all clupeid species tested have demonstrated this very high-frequency hearing. Mann et al. (1998) reported that the American shad can detect sounds from 0.1 to 180 kHz with two regions of best sensitivity: one from 0.2 to 0.8 kHz, and the other from 25 kHz to 150 kHz. This shad species has relatively high thresholds (about 145 decibels relative to 1 dB re 1 µPa), which should enable the fish to detect odontocete clicks at distances up to about 656 ft. (200 m) (Mann et al. 1997). In contrast, the Clupeidae bay anchovy (*Anchoa mitchilli*), scaled sardine (*Harengula jaguana*), and Spanish sardine (*Sardinella aurita*) did not respond to frequencies over 4 kHz (Gregory and Clabburn 2003; Mann et al. 2001b). Mann et al. (2005b) found hearing thresholds of 0.1 kHz to 5 kHz for Pacific herring (*Clupyea pallasii*).

Two other groups to consider are the jawless fish (Superclass: Agnatha – lamprey) and the cartilaginous fish (Class: Chondrichthyes—the sharks, rays, and chimeras). While there are lampreys in the marine environment, virtually nothing is known about their hearing capability. They do have ears, but these are relatively primitive compared to the ears of other vertebrates, and it is unknown whether they can detect sound (Popper and Hoxter 1987). While there have been some studies on the hearing of cartilaginous fish, these have not been extensive. However, available data suggest detection of sounds from 20 to 1,000 Hz, with best sensitivity at lower ranges (Casper et al. 2003b; Casper and Mann 2006b; Casper and Mann 2009; Myrberg 2001). It is likely that elasmobranchs only detect low-frequency sounds because they lack a swim bladder or other pressure detector.

Most other marine species investigated to date lack higher-frequency hearing (i.e., greater than 1,000 Hz). This notably includes sturgeon species tested to date that could detect sound up to 400 or 500 Hz (Lovell et al. 2005; Meyer et al. 2010)and Atlantic salmon that could detect sound up to about 500 Hz (Hawkins and Johnstone 1978b; Kane et al. 2010).

Bony fish can produce sounds in a number of ways and use them for a number of behavioral functions (Ladich 2008). Over 30 families of fish are known to use vocalizations in aggressive interactions, and over 20 families are known to use vocalizations in mating (Ladich 2008). Sound generated by fish as a means of communication is generally below 500 Hz (Slabbekoorn et al. 2010a). The air in the swim bladder is vibrated by the sound producing structures (often muscles that are integral to the swim bladder wall) and radiates sound into the water (Zelick et al. 1999). Sprague and Luczkovich (2004) calculated that silver perch can produce drumming sounds ranging from 128 to 135 dB re 1µ Pa. Female midshipman fish apparently use the auditory sense to detect and locate vocalizing males during the breeding season (Sisneros and Bass 2003a).

3.9.2.2 General Threats

This section covers the existing condition of marine fishes as a resource and presents some of the major threats within the Study Area. Species-specific threats are addressed for each of the ESA-listed species. Human-made impacts are widespread throughout the world's oceans, such that very few habitats remain unaffected by human influence (Halpern et al. 2008). These stressors have shaped the condition of marine fish populations, particularly those species with large body sizes and late maturity ages, making these species especially vulnerable to habitat losses and fishing pressure (Reynolds et al. 2005). This trend is evidenced by the world's shark species, which make up 60 percent of the marine fishes of conservation concern (International Union for Conservation of Nature and Natural Resources 2009). Furthermore, the conservation status of only 3 percent of the world's marine fish species has been evaluated, so the threats to the remaining species are largely unknown at this point (Reynolds et al. 2005).

Overfishing is the most serious threat that has led to the listing of ESA-protected marine species (Crain et al. 2009; Kappel 2005), with habitat loss also contributing to extinction risk (Cheung et al. 2007; Dulvy et al. 2003; Jonsson et al. 1999; Limburg and Waldman 2009; Musick et al. 2000). Approximately 30 percent of the United States-managed fishery stocks are overfished (National Marine Fisheries Service 2009). Overfishing occurs when fishes are harvested in quantities above a sustainable level. Overfishing impacts targeted species, and non-targeted species (or "bycatch" species) that often are prey for other fishes and marine organisms. Bycatch may also include seabirds, turtles, and marine mammals. Additionally, in recent decades the marine fishes being targeted have changed such that when higher-level predators become scarce, different organisms on the food chain are subsequently targeted; this has negative implications for entire marine food webs (Crain et al. 2009; Pauly and Palomares 2005). Other factors, such as fisheries-induced evolution and intrinsic vulnerability to overfishing, have been shown to reduce the abundance of some populations (Kauparinen and Merila 2007). Fisheries-induced evolution describes a change in genetic composition of the population that results from intense fishing pressure, such as a reduction in the overall size and growth rates of fish in a population. Intrinsic vulnerability describes certain life history traits (e.g., large body size, late maturity age, low growth rate) that result in a species being more susceptible to overfishing than others (Cheung et al. 2007).

Pollution primarily impacts coastal fishes that occur near the sources of pollution. However, global oceanic circulation patterns result in a considerable amount of marine pollutants and debris scattered throughout the open ocean (Crain et al. 2009). Pollutants in the marine environment that may impact marine fishes include organic pollutants (e.g., pesticides, herbicides, polycyclic aromatic hydrocarbons, flame retardants, and oil), inorganic pollutants (e.g., heavy metals), and debris (e.g., plastics and wastes from dumping at sea) (Pew Oceans Commission 2003). High chemical pollutant levels in marine fishes may cause behavioral changes, physiological changes, or genetic damage in some species (Goncalves et al. 2008; Moore 2008; Pew Oceans Commission 2003; van der Oost et al. 2003). Bioaccumulation of pollutants (e.g., metals and organic pollutants) is also a concern, particularly in terms of human health, because people consume top predators with high pollutant loads. Bioaccumulation is the net buildup of substances (e.g., chemicals or metals) in an organism directly from contaminated water or sediment through the gills or skin, from ingesting food containing the substance (Newman 1998), or from ingestion of the substance itself (Moore 2008). Entanglement in abandoned commercial and recreational fishing gear has also caused pollution-related declines for some marine fishes; some species are more susceptible to entanglement by marine debris than others (Musick et al. 2000).

Other human-caused stressors on marine fishes are the introduction of non-native species, climate change, aquaculture, energy production, vessel movement, and underwater noise:

- Non-native fishes and invertebrates pose threats to native fishes when they are introduced into an environment lacking natural predators and then compete with, and prey upon, native marine fishes for resources (Crain et al. 2009).
- Global climate change is contributing to a shift in fish distribution from lower to higher latitudes (Brander 2010; Brander 2007; Dufour et al. 2010; Glover and Smith 2003; Limburg and Waldman 2009; Wilson et al. 2010).
- The threats of aquaculture operations on wild fish populations are reduced water quality, competition for food, predation by escaped or released farmed fishes, spread of disease, and reduced genetic diversity (Kappel 2005). These threats become apparent when escapees enter the natural ecosystem (Hansen and Windsor 2006; Ormerod 2003). The National Oceanic and Atmospheric Administration developed an aquaculture policy aimed at promoting sustainable marine aquaculture (National Oceanic and Atmospheric Administration 2011a).
- Energy production and offshore activities associated with power-generating facilities results in direct and indirect fish injury or mortality from two primary sources; cooling water withdrawal that results in entrainment mortality of eggs and larvae and impingement mortality of juveniles and adults (U.S. Environmental Protection Agency 2004), and offshore wind energy development that results in acoustic impacts (Madsen et al. 2006).
- Vessel strikes pose threats to some large, slow-moving fishes at the surface. Whale sharks, basking sharks, ocean sunfish, and manta rays are vulnerable to ship strikes, and numerous collisions have been recorded (National Marine Fisheries Service 2010; Rowat et al. 2007b; Stevens 2007).
- Underwater noise is a threat to marine fishes. However, the physiological and behavioral responses of marine fishes to underwater noise (Codarin et al. 2009; Popper 2003a)(Slabbekoorn et al. 2010b; Wright et al. 2010) have been investigated for only a limited number of species (Popper and Hastings 2009a, b). In addition to vessels, another source of underwater noise includes seismic activity, pile driving, and offshore energy projects such as hydrokinetic and wind farm structures (Popper and Hastings 2009a). Information on fish hearing is provided in Section 3.9.2.1 (Hearing and Vocalization), with further discussion in Section 3.9.3.1 (Acoustic Stressors).

3.9.2.3 Endangered Species Act-Listed Species

This section describes ESA-listed species that are present within the Study Area, and critical habitat that has been designated or proposed within the Study Area that might conceivably be affected by the proposed action. Information on the spatial and temporal distribution, life history, and ecological requirements of species known to occur in the Study Area is presented below. Critical habitat and the associated Primary Constituent Elements (PCEs), if applicable, within the Study Area are identified and described. Potential impacts to critical habitat were assessed by determining the effects of the project on the PCEs of the critical habitat. Critical habitat is defined as (1) specific areas within the geographical area occupied by the species at the time of listing, if those areas contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. PCEs are defined as sites or habitat components that support one or more life stages deemed essential to the conservation of the species.

Critical habitat maps were only provided for species in which the critical habitat extended into the Study Area.

3.9.2.3.1 Salmonid Species

Juveniles and adults of all anadromous salmonid ESUs and DPSs in the Study Area traverse estuaries en route to and from the Pacific Ocean, including in the Inland Waters of the Study Area. The length of time spent in a given estuary is determined by a combination of environmental conditions (i.e., river discharge, water temperature), intrinsic biological differences (sex and population), and physiological and energetic status. There is extensive variation in migration behavior among individuals, sexes, and populations.

Adult salmonids may enter an estuary year-round, although they may spend several weeks staging in the estuary prior to moving upstream. Juvenile salmon of one species or another may also be present throughout the year. Different species, size classes, and life history types continually move downstream and enter tidal waters. The juveniles of some salmonid species, such as sockeye salmon or steelhead, will migrate quickly through an estuary. The juveniles of other species, notably chum salmon and ocean-type Chinook salmon, are smaller in size and favor shallower, slower water habitats along river margins, thus taking appreciably longer to move through an estuary.

The quantity and quality of critical habitat are evaluated by reference to PCEs, defined as those sites and habitat components that support one or more life stages and are deemed essential for the conservation of the species. The six PCEs include:

- **Freshwater spawning sites** with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. These features are essential to conservation; without them, the species cannot successfully spawn and produce offspring. The Study Area does not extend into any freshwater sites; therefore this PCE is not present in the Study Area.
- **Freshwater rearing sites** with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation; without them, juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival. The Study Area does not extend into any freshwater sites; therefore this PCE is not present in the Study Area.
- **Freshwater migration corridors** free of obstruction 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. These features are essential to conservation; without them, juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a nonfeeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores. The Study Area does not extend into any freshwater spawning; therefore this PCE is not present in the Study Area.
- **Estuarine areas** free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh water and salt water; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks

and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. These features are essential to conservation; without them, juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas. The Study Area does not extend into any estuarine designated PCEs.

- **Nearshore marine areas** free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. As in the case with freshwater migration corridors and estuarine areas, nearshore marine features are essential to conservation because without them juveniles cannot successfully transition from natal streams to offshore marine areas. NMFS focused the designation of this PCE on nearshore areas in Puget Sound because of its unique and relatively sheltered fjord-like setting. There are two salmonid species (chum and Chinook) with nearshore marine area PCEs in the Study Area (Figure 3.9-1 and Figure 3.9-2).
- **Offshore marine areas** with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. These features are essential for conservation because without them juveniles cannot forage and grow to adulthood. However, it is difficult to identify specific areas containing this PCE as well as human activities that may affect the PCE condition in those areas. Therefore, NMFS has not designated any specific areas based on this PCE but instead has identified it because it is essential to the species' conservation and specific offshore areas may be identified in the future (70 Federal Register [FR] 52630-52858). Therefore, since this PCE has not yet been designated, it will not be considered in this analysis.

3.9.2.3.1.1 Chinook Salmon (*Oncorhynchus tshawytscha*)

Occurrence in the Study Area

Chinook salmon may occur in the all portions of the Study Area. Additionally, near shore critical habitat is located in the Inland Waters of the Study Area (Figure 3.9-1). The Puget Sound ESU will only occur in the Inland Waters. The California Coastal, Lower Columbia River, Upper Columbia River, Upper Klamath and Trinity River Basin, Snake River Fall-Run, Snake River Spring/Summer Run, and Upper Willamette River ESUs will only occur in the Offshore Area (see Table 3.9-1).

Status and Management

Of the 17 Chinook salmon DPSs, 2 are listed as endangered, 7 are listed as threatened, 1 is listed as a candidate species, and 1 is an ESA species of concern (National Marine Fisheries Service 2012b). Critical habitat for 9 Chinook salmon DPSs has been designated (National Marine Fisheries Service 2012b) (Figure 3.9-1). In addition to the critical habitat, PCEs have been designated near the Study Area (Figure 3.9-1). Management of Pacific salmon is through the Pacific Salmon Commission. The Commission was formed by the governments of Canada and the United States to implement the Pacific Salmon Treaty. The Commission does not regulate the salmon fisheries but does provide regulatory advice and recommendations.

Figure 3.9-1: Chinook Salmon Critical Habitat in the Northwest Training and Testing Study Area

Puget Sound ESU

On 28 June 2005, the Puget Sound Chinook salmon ESU was listed as threatened (70 FR 37160-37204). This ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Strait of Juan de Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington, and 26 artificial propagation programs. These programs include Kendal Creek Hatchery, Marblemount Hatchery (fall, spring yearlings, spring subyearlings, and summer run), Harvey Creek Hatchery, Whitehorse Springs Pond, Wallace River Hatchery (yearlings and subyearlings), Tulalip Bay, Issaquah Hatchery, Soos Creek Hatchery, Icy Creek Hatchery, Keta Creek Hatchery, White River Hatchery, White Acclimation Pond, Hupp Springs Hatchery, Voights Creek Hatchery, Diru Creek, Clear Creek, Kalama Creek, George Adams Hatchery, Rick's Pond Hatchery, Hamma Hamma Hatchery, Dungeness/Hurd Creek Hatchery, and Elwha Channel Hatchery.

Upper Columbia River ESU

The Upper Columbia River Spring-run Chinook ESU was listed as endangered on 28 June 2005 (70 FR 37160-37204). This ESU includes all naturally spawned populations of spring Chinook salmon in all river reaches accessible to spring Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington, and six artificial propagation programs. These propagation programs include Twisp River, Chewuch River, Methow Composite, Winthrop National Fish Hatchery, Chiwawa River, and White River.

Lower Columbia River ESU

On June 28, 2005, the Lower Columbia River Chinook Salmon ESU was listed as threatened (70 FR 37160-37204). This ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean, upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River and 17 artificial propagation programs.

Upper Willamette River ESU

The Willamette River Chinook salmon ESU was listed as threatened on 28 June 2005 (70 FR 37160-37204). This ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and Willamette River, and its tributaries, above Willamette Falls, Oregon, and seven artificial propagation programs. The artificial propagation programs are the McKenzie River Hatchery (Oregon Department of Fish and Wildlife [ODFW] stock #24), Marion Forks/North Fork Santiam River (ODFW stock #21), South Santiam Hatchery (ODFW stock #23) in the South Fork Santiam River, South Santiam Hatchery in the Calapooia River, South Santiam Hatchery in the Mollala River, Willamette Hatchery (ODFW stock #22), and Clackamas hatchery (ODFW stock #19).Central Valley Spring-Run ESU

On 16 September 1999, the Central Valley Spring-run Chinook salmon ESU was listed as threatened, and it was reaffirmed as threatened on 25 June 2005 (70 FR 37160). Populations included in this ESU occur in Deer, Mill, and Butte creeks, as well as Big Chico, Antelope, Clear, Thomes, and Beegum creeks. A population also occurs in the Feather River but it is dependent on Feather River Hatchery production which is also considered part of the ESU but has hybridized with fall-run Chinook.

Snake River Spring/Summer Run ESU

On 28 June 2005, the Snake River Chinook salmon spring/summer-run ESU was listed as threatened (70 FR 37160-37204). This ESU includes all naturally spawned populations of spring/summer-run Chinook

salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins, and 15 artificial propagation programs. These artificial propagation programs include the Tucannon River conventional Hatchery, Tucannon River Captive Broodstock Program, Lostine River, Catherine Creek, Lookingglass Hatchery, Upper Grande Ronde, Imnaha River, Big Sheep Creek, McCall Hatchery, Johnson Creek Artificial Propagation Enhancement, Lemhi River Captive Rearing Experiment, Pahsimeroi Hatchery, East Fork Captive Rearing Experiment, West Fork Yankee Fork Captive Rearing Experiment, and Sawtooth Hatchery.

Snake River Fall Run ESU

The Snake River Chinook salmon fall-run ESU was listed as threatened on 28 June 2005 (70 FR 37160-37204). This ESU includes all naturally spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam, and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River, and four artificial propagation programs: the Lyons Ferry Hatchery, Fall Chinook Acclimation Ponds Program, Nez Perce Tribal Hatchery, and Oxbow Hatchery fall-run Chinook hatchery programs.

California Coastal ESU

On 16 September 1999 the California Coastal Chinook salmon ESU was listed as threatened, and it was reaffirmed 28 June 2005 (70 FR 37160). This ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River to the Russian River, and seven artificial propagation programs that were considered part of the ESU at the time of listing: the Humboldt Fish Action Council, Yager Creek, Redwood Creek, Hollow Tree, Van Arsdale Fish Station, Mattole Salmon Group, and Mad River Hatchery fall-run Chinook hatchery programs. The Mad River Hatchery no longer rears or produces any Chinook salmon.

Central Valley Spring-Run ESU

On 16 September 1999 the Central Valley Spring-Run Chinook salmon ESU was listed as threatened (64 FR 50394). This ESU includes all naturally spawned populations of spring-run Chinook salmon from the Sacramento River and its tributaries in California, including the Feather River. One artificial propagation program is considered part of the ESU, the Feather River hatchery spring-run Chinook program.

Sacramento River Winter Run ESU

On 4 January 1994 the Sacramento River Winter Run Chinook salmon ESU was listed as endangered (59 FR 10104). This ESU includes all naturally spawned populations of winter-run Chinook salmon in the Sacramento River and its tributaries in California. It also includes two artificial propagation programs: winter-run Chinook from the Livingston Stone National Fish Hatchery, and winter-run Chinook in a captive broodstock program maintained at Livingston Stone National Fish Hatchery and the University of California Bodega Marine Laboratory.

Population and Abundance

Most of the DPSs for Chinook salmon have a low abundance relative to historical levels. NMFS has reported population sizes from individual DPSs, but because all of these units occur together while at sea, it is difficult to estimate the marine population numbers in the Study Area. Specific population numbers, based on freshwater returns, within each of the DPSs is found in Good et al. (2005).Life History

The general life history of anadromous Chinook salmon includes both freshwater and saltwater phases of development. Incubation, hatching, and emergence occur in fresh water, followed by migration to the ocean, at which time smoltification occurs. After several years, maturation is initiated and adults return

to freshwater habitats to spawn in their natal streams. Stream-type Chinook salmon spend extended periods in fresh water before smoltification, in contrast to the ocean-type that immigrates to the ocean as sub-yearling smolts. The general life history of anadromous Chinook salmon includes both freshwater and saltwater phases of development. Incubation, hatching, and emergence occur in fresh water, followed by migration to the ocean, at which time smoltification occurs. After several years, maturation is initiated and adults return to freshwater habitats to spawn in their natal streams. Stream-type Chinook salmon spend extended periods in fresh water before smoltification, in contrast to the ocean-type that immigrates to the ocean as sub-yearling smolts.

There is considerable variation in this life history pattern within the population. Chinook salmon can be divided into two basic types. The first is the stream-type, which have a longer freshwater residency. The second is the ocean- type, which have a shorter freshwater residency. Coastal streams are dominated by the ocean-type, whereas the stream-type are mainly found in the headwater streams of larger river systems (National Marine Fisheries Service 2012b).

Habitat and Geographic Range

The present distribution of Chinook salmon extends from Hokkaido Island in Japan, east to Alaska, and south to central California, although the species' historical range extended to the Ventura River in California (National Marine Fisheries Service 2012b). Because of their large body size, Chinook salmon tend to use deeper water and larger gravel size to spawn than other salmonids. Since spawning occurs exclusively in freshwater systems outside of the Study Area, spawning habitats are not described here. However, information on freshwater habitats and spawning areas can be found in Good et al. (2005).

Predator/Prey Interactions

Predators of Chinook salmon include fish-eating birds, and marine mammals, such as sea lions, harbor seals, and Southern Resident Killer Whales, especially within coastal areas (National Marine Fisheries Service 2012b). Juveniles in fresh water feed mostly on insects, amphipods, and crustaceans, while adults feed on other fish (National Marine Fisheries Service 2012b).

Migration

Adult Chinook salmon migrate from their ocean habitats to reach their freshwater spawning grounds in high elevation tributaries. Although Chinook salmon can be found entering rivers throughout the year, the majority return from April to December. Fall Chinook are most abundant, followed by spring Chinook. Populations originating north of Cape Blanco, Oregon migrate north to the Gulf of Alaska, while populations originating south of Cape Blanco migrate south and west into the waters off California and Oregon. Chinook salmon spawning in rivers south of the Rogue River in Oregon rear in marine waters off California and Oregon, whereas, salmon spawning in rivers north of the Rogue River migrate north and west along the Pacific coast.

Species-Specific Threats

There are many threats to the survival of Chinook salmon DPSs found within the Study Area. Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of Chinook salmon.

3.9.2.3.1.2 Coho Salmon (*Oncorhynchus kisutch*)

Occurrence in the Study Area

Coho salmon may occur in the all portions of the Study Area. The Puget Sound/Strait of Georgia ESU will occur in the Inland Waters. Adults of the Lower Columbia, Oregon Coast, and Southern Oregon and Northern California Coasts ESUs will occur in the Offshore Area (see Table 3.9-1).

Status and Management

Of the seven coho DPSs, one is listed as endangered, three are listed as threatened, and one is an ESA species of concern (National Marine Fisheries Service 2012e). Critical habitat for two of the coho salmon DPSs (Northern California-Southern Oregon coasts and Lower Columbia River and Oregon Coast) was designated in May 1999 (National Marine Fisheries Service 2012e); however, it does not overlap with the Study Area.

Lower Columbia ESU

The Lower Columbia Coho salmon ESU was listed as threatened on 28 June 2005 (70 FR 37106-37204). This ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls, Oregon, and 25 artificial propagation programs. These programs include Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Washougal Hatchery Type-N Coho Program, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Eagle Creek National Fish Hatchery, Sandy Hatchery, and Bonneville/Cascade/Oxbow complex.

Oregon Coast ESU

On 20 June 2011, the Oregon Coast Coho salmon ESU was listed as threatened (76 FR 35755-35771). This ESU includes all naturally spawned populations of Coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco, including the Cow Creek (ODFW stock #37) Coho hatchery program.

Southern Oregon and Northern California ESU

The Southern Oregon and Northern California Coho salmon ESU was listed as threatened on 28 June 2005 (70 FR 37160). This ESU includes all naturally spawned populations of Coho salmon in coastal streams between Cape Blanco, Oregon, and Punta Gorda, California, and three artificial propagation programs. These programs are Cole Rivers Hatchery (ODFW stock #52), Trinity River Hatchery, and Iron Gate Hatchery.

Central California Coast ESU

The Central California Coast Coho salmon ESU was listed as endangered on 2 April 2012 (77 FR 19552). This ESU all naturally spawned populations of coho salmon from Punta Gorda in northern California south, to and including the San Lorenza River in central California. It also includes populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. Four artificial propagation programs are part of this ESU: the Don Clausen Fish Hatchery Captive Broodstock Program,

the Scott Creek/Kind Fisher Flats Conservation Program, the Scott Creek Captive Broodstock Program, and the Noyo River Fish Station egg-take Program.

Population and Abundance

Most of the DPSs have a low abundance relative to historical levels and have seen decreases in recent years (National Marine Fisheries Service 2012e). NMFS has reported population sizes from individual DPSs, but because all of these units occur together while at sea, it is difficult to estimate the marine population numbers. Specific population numbers, based on freshwater returns, within each of the DPSs is found in Good et al. (2005).

Life History

Puget Sound populations are generally found in the Strait of Juan de Fuca and the coastal waters of Vancouver Island during the summer months (Pacific Fishery Management Council 2000). As populations leave Puget Sound they can be found migrating northward along the east or west coast of Vancouver Island and out into the Pacific Ocean (Pacific Fishery Management Council 2000). Coho migrating from Oregon streams may initially be found south of their natal streams due to strong southerly currents (Pacific Fishery Management Council 2000). These currents weaken during the winter months and the salmon migrate northward (Pacific Fishery Management Council 2000).

Habitat and Geographic Range

The historic distribution of coho salmon extended from Hokkaido Island in Japan, east to Alaska, and south to central California; however, some populations are now considered extinct (National Marine Fisheries Service 2012e). Since spawning occurs exclusively in freshwater systems outside of the Study Area, spawning habitats are not described here. However, information on freshwater habitats and spawning areas can be found in Good et al. (2005).

Predator/Prey Interactions

Predators of coho salmon include fish-eating birds, and marine mammals, such as sea lions and harbor seals, especially within coastal areas (National Marine Fisheries Service 2012e). Juveniles in fresh water feed mostly on insects and plankton, while adults feed on other fish (National Marine Fisheries Service 2012e).

Migration

Coho will migrate from the freshwater habitats to the open ocean after spending approximately 18 months in these areas. Within the Study Area most adult coho salmon migrate north from their respective freshwater habitats (Pacific Fishery Management Council 2000). Tag, release, and recovery studies suggests that coho salmon of California origin can be found as far north as southeast Alaska and salmon from Oregon and Washington as far north as the northern Gulf of Alaska (Pacific Fishery Management Council 2000).

Species-Specific Threats

There are many threats to the survival of coho salmon DPSs found within the Study Area. Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of coho salmon.

3.9.2.3.1.3 Chum Salmon (*Oncorhynchus keta*)

Occurrence in the Study Area

Chum salmon may occur in the all portions of the Study Area. Additionally, near shore critical habitat is located in the Inland Waters of the Study Area (Figure 3.9-2). The Hood Canal Summer-Run ESU will occur in the Inland Waters portion of the Study Area. The Columbia River ESU will occur in the Offshore Area (see Table 3.9-1).

Status and Management

Hood Canal Summer-run ESU

The Hood Canal Summer-run Chum salmon ESU was listed as threatened on 28 June 2005 (70 FR 37160). This ESU includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries, plus populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington, and eight artificial propagation programs. These programs include the Quilcene National Fish Hatchery, Hamma Hamma Fish Hatchery, Lilliwaup Creek Fish Hatchery, Union River/Tahuya, Big Beef Creek Fish Hatchery, Salmon Creek Fish Hatchery, Chimacum Creek Fish Hatchery, and the Jimmycomelately Creek Fish Hatchery.

Critical habitat for the chum salmon is designated in Hood Canal as well as major spawning rivers in Washington and on the coast of Oregon (Figure 3.9-2). This critical habitat was designated on 2 September 2005, for the threatened Columbia River and Hood Canal Summer-Run ESUs (National Marine Fisheries Service 2012c). In addition to the critical habitat, PCEs have been identified near the Study Area (Figure 3.9-2).

Columbia River ESU

On 28 June 2005, the Columbia River Chum salmon ESU was listed as threatened (70 FR 37160). This ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon, and three artificial propagation programs: the Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek chum hatchery programs.

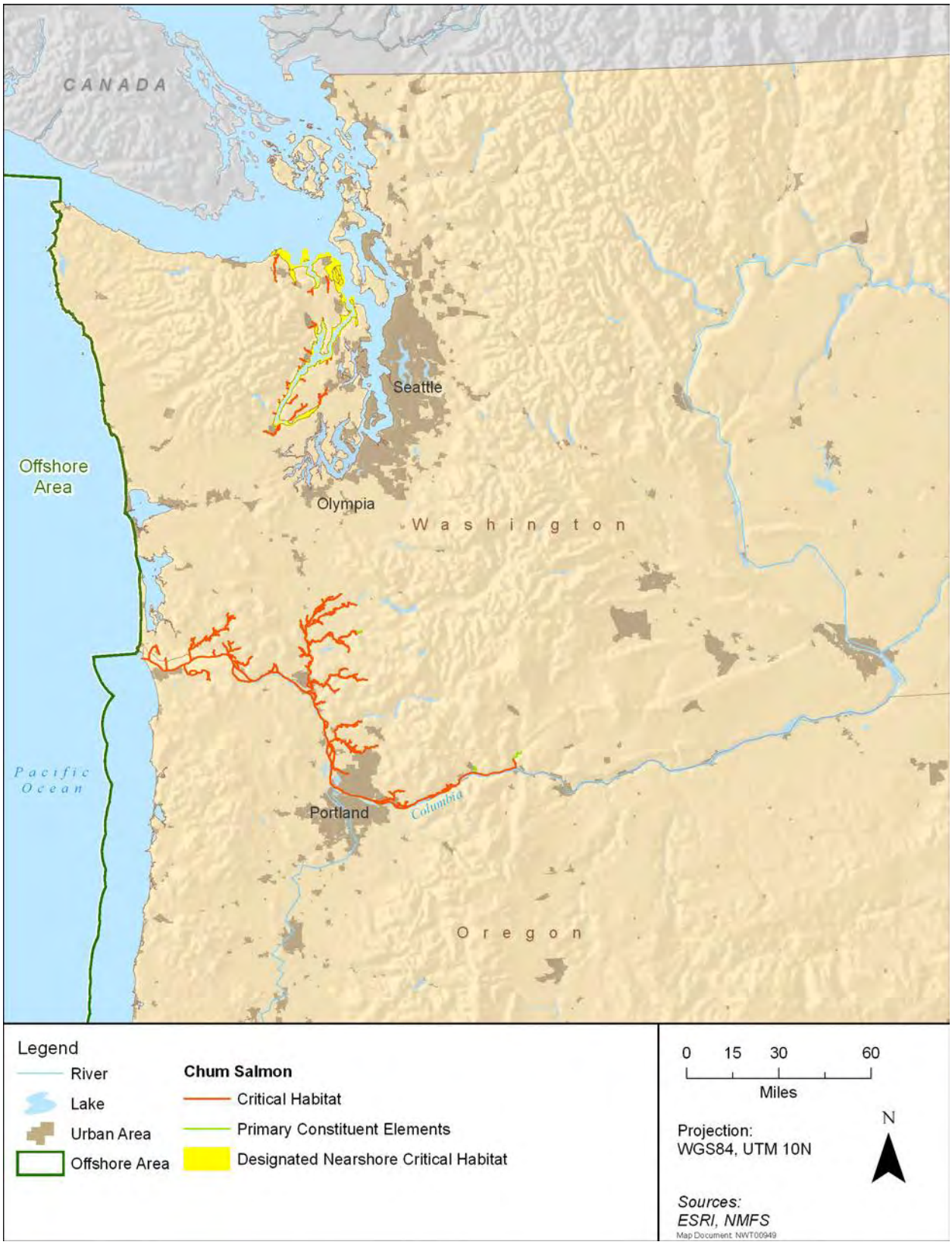

Figure 3.9-2: Chum Salmon Critical Habitat in the Northwest Training and Testing Study Area

The recreational and commercial salmon fishing seasons for chum are set in the same manner as other salmon fisheries. This method reviews the pre-season forecast of abundance and then designs fisheries that open in areas and during times when healthy stock predominate and weak stocks are relatively unaffected. Hood Canal Summer Chum are of special concern because of their threatened status under the ESA. Consequently, fishing for chum salmon is prohibited in Hood Canal and Admiralty Inlet through the summer and early fall. The fall and winter chum runs in Puget Sound are very healthy. The run size of fall chum is monitored in-season by test fisheries in Area 20 south of Vancouver Island as the fish pass through the Strait of Juan de Fuca and during October in Puget Sound in the vicinity of Apple Cove Point. If these test fisheries indicate the run is either much larger or much smaller than predicted in the pre-season forecast then commercial seasons are adjusted accordingly. Because the recreational harvest of chum is still relatively small, in-season adjustments to recreational fishing seasons focused on chum are rare (Washington Department of Fish and Wildlife 2012a). The Pacific Coast Salmon Recovery Fund was established by Congress in 2000 to support the restoration of salmon species (National Marine Fisheries Service 2012d).

Life History

Chum salmon spend more of their life history in marine waters than most other Pacific salmonids. Chum salmon usually spawn in the lower reaches of streams, and juveniles out-migrate to the estuary almost immediately after emerging from their spawning gravel. This means survival and growth in juvenile chum salmon depends less on freshwater conditions than on favorable estuarine and marine conditions. After spending between 1–4 years in the ocean, chum salmon return to their home freshwater stream to spawn. Like other species of Pacific salmon, chum salmon die after spawning and are not able to spawn more than once.

Age at maturity appears to follow a latitudinal trend in which a greater number of fish mature at a later age in the northern portion of the species' range. Most chum salmon mature and return to their birth stream to spawn between 3 and 5 years of age, with 60–90 percent of the fish maturing at 4 years of age.

Population and Abundance

With 17 different populations, chum salmon may have historically been the most abundant of all Pacific salmonids. Currently, however, the vast majority (14 out of 17) of chum salmon populations from the Columbia River remain extirpated or nearly so. Grays River and the lower Gorge area ESU populations are the only locations that have consistently maintained natural spawning. In 2002, Grays River and the lower Gorge populations showed a sharp increase; however, recent data indicate that abundances have returned to their previous relatively low levels of a few thousand in the Grays and less than a thousand in the lower Gorge. The Grays River data also includes a hatchery program that was initiated in early 1999, and coincides with the large increase in abundance for that population in 2002 (Ford 2011).

Currently it is thought that 14 of the 16 spawning populations in the Columbia River ESU are extinct. About 500 spawners occur in the ESU presently and the long-term trend is flat (National Marine Fisheries Service 2012c).

Habitat and Geographic Range

Chum salmon have the widest natural geographic and spawning distribution of any Pacific salmonid. Its range extends along the shores of the Arctic Ocean farther than that of the other salmonids. Spawning populations are known from Korea and Japan and into the far north of Russia. Major spawning

populations on the West Coast of the United States occur from Alaska only as far south as Tillamook Bay on the Northern Oregon coast.

Predator/Prey Interactions

Predation effects on chum salmon are primarily caused by various fish species and birds during the juvenile life stage, and large fish species and marine mammals during the adult life history stage. Predation on juvenile chum does not normally threaten the success of chum populations unless they are subjected to unusual aggregations of the predators. The release of hatchery fish of a variety of species is a common reason for large predator aggregations, and in some situations, this practice has been shown to negatively impact the survival of chum salmon juveniles (Washington Department of Fish and Wildlife 2012a). Chum salmon feed on insects and marine invertebrates while in rivers, and as adults their diet consists of copepods, fishes, mollusks, squid, and tunicates (National Marine Fisheries Service 2012c).

Migration

Chum salmon migrate from their ocean habitats to reach their freshwater spawning grounds in high elevation tributaries. In Puget Sound, Washington and Oregon coast portions of the Study Area although some of these rivers contain considerable migration barriers such as dams.

Species-Specific Threats

There are many threats to the survival of the Hood Canal Summer-run ESU of chum salmon. Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of Pacific Northwest chum salmon.

3.9.2.3.1.4 Sockeye Salmon (*Oncorhynchus nerka*)

Occurrence in the Study Area

Adults of both the Snake River and the Ozette Lake ESUs will occur in the Offshore Area (Table 3.9-1).

Status and Management

Sockeye salmon are the third-most abundant of the seven species of Pacific salmon, after pink salmon and chum salmon. Critical habitat for two of the sockeye salmon ESUs was designated for the Snake River on 28 December 1993, and for the Ozette Lake ESU on 2 September 2005 (National Marine Fisheries Service 2013). The Snake River ESU has remained at low levels of only a few hundred fish; however, there may have been recent increases in number of hatchery reared fish returning to the Snake River to spawn. The Ozette Lake ESU is a small population, but possibly growing (National Marine Fisheries Service 2013).

Ozette Lake ESU

The Ozette Lake Sockeye salmon ESU was listed as threatened on 28 June 2005 (70 FR 37160). This ESU includes all naturally spawned populations of sockeye salmon in Ozette Lake and streams and tributaries flowing into Ozette Lake, Washington, and two artificial propagation programs. The programs are Umbrella Creek and Big River.

The historical abundance of Ozette Lake, located in the Olympic National Park in Washington, sockeye salmon is poorly documented; however, the overall abundance of naturally produced Ozette Lake sockeye salmon is believed to have declined substantially from historical levels. In the 1940s the first estimates of escapement of Ozette Lake sockeye salmon are estimated at a level of several thousand

fish. These counts appear to be roughly double the current mean lake abundance. Recent year sockeye salmon escapements have averaged below 1,000 adults per year, with low years dropping to only a few hundred fish. The Ozette Lake sockeye salmon population was listed as a threatened ESU under the ESA on 25 March 1999. NMFS concluded that the ESU was likely to become endangered in the foreseeable future if present conditions persisted.

The listed sockeye salmon ESU includes all naturally spawned sockeye salmon that reside below impassable natural barriers in Ozette Lake and its tributaries. The sockeye salmon reared at the Makah Tribe's Umbrella Creek Hatchery are also considered part of the unit but not considered essential for recover of the unit. There have been no harvests of Ozette Lake sockeye salmon for the past 16 years. There are currently no known marine area harvest impacts on the Ozette Lake sockeye salmon (Washington Department of Fish and Game 2012b). The Pacific Coast Salmon Recovery Fund was established by Congress in 2000 to support the restoration of salmon species (National Marine Fisheries Service 2012d).

Snake River ESU

On 28 June 2005, the Snake River Sockeye ESU was listed as threatened (70 FR 37160). This ESU includes all anadromous and residual sockeye salmon from the Snake River Basin, Idaho, and artificially propagated sockeye salmon from the Redfish Lake captive propagation program.

Population and Abundance

Sockeye salmon are the third most abundant of the seven species of Pacific salmon after pink salmon and chum salmon. However, the Snake River ESU has remained at very low levels of only a few hundred fish, though recent hatchery reared fish have returned to spawn. Data quality for the Ozette Lake ESU makes differentiating between the number of hatchery and natural spawners difficult; however the size of the population is small, though possibly growing (National Marine Fisheries Service 2012d).

Life History

Sockeye salmon spawn in or near lakes, where the juveniles rear for 1–3 years prior to migrating to sea. As the time for migration to the sea approaches for the anadromous forms, the juvenile loses its parr marks, and gains the dark back and light belly coloration of fish living in open water. During this time their gills and kidneys change so that they can process salt water. These "smolts" initially stay close to the shore, then grow and move offshore for bigger prey. After spending between 2 and 4 years in the ocean, sockeye salmon return to their home freshwater lake to spawn. Like other species of Pacific salmon, sockeye salmon die after spawning and are not able to spawn more than once.

There are some sockeye that are non-anadromous, which means that they spend their entire lives in fresh water. Non-anadromous forms in the Pacific Northwest are known as "kokanee." Occasionally, a proportion of the juveniles in an anadromous sockeye salmon population will remain in their rearing lake environment throughout life and will be observed on the spawning grounds together with their anadromous siblings (National Marine Fisheries Service 2012d).

Habitat and Geographic Range

Sockeye salmon inhabit riverine, marine, and lake environments from the Klamath River and its tributaries north and west to the Kuskokwim River in western Alaska. They generally require lakes for part of their life cycle; therefore, their distribution in river systems depends on the presence of usable lakes in the system, so their habitat can be more intermittent than for other Pacific salmon. Sockeye salmon are also found in Asia from the Anadyr River in Siberia south to Hokkaido, Japan. Critical habitat

was designated for the Snake River ESU on 28 December 1993, and for the Ozette Lake ESU on 2 September 2005 (National Marine Fisheries Service 2012d), which is outside of the Study Area. The Ozette Lake ESU is found in a small part of the Study Area. In addition to the critical habitat, PCEs have been identified near the Study Area.

Predator/Prey Interactions

Sockeye smolts (juveniles turning into adults) migrate to sea in spring at a length of approximately 4–6 inches (in.) (15 centimeters [cm]) and are subjected to intense predation by a variety of fish and bird species. Squawfish and trout have been identified as especially significant predators during this outmigration life phase, and gulls and grebes are some of the significant avian predators of sockeye smolts. In the near shore and open ocean environments, predation by fish, birds, and marine mammals, and competition for food resources with other fish species affects growth and survival of sockeye salmon (Washington Department of Fish and Wildlife 2012b). In fresh water, the sockeye salmon feeds on aquatic insects and plankton; however, in the ocean, they eat amphipods, copepods, squid, and some fishes.

Migration

Sockeye salmon migrate from marine environments to freshwater streams and rivers or lakes of their birth to mate. Sockeye salmon also have various life history patterns which highlight different dependencies on the freshwater streams and rivers.

Species-Specific Threats

There are many threats to the survival of the Ozette Lake ESU of sockeye salmon. Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of Pacific Northwest sockeye salmon.

3.9.2.3.1.5 Steelhead (*Oncorhynchus mykiss*)

Occurrence in the Study Area

Steelhead may occur in the Inland Waters and the Offshore Area. The Puget Sound DPS will occur in the Inland Waters. The Snake River Basin, Upper Columbia River, Middle Columbia River, Lower Columbia River, Upper Willamette River, Northern California, and Oregon Coast DPSs will occur in the Offshore Area (see Table 3.9-1).

Status and Management

Of the 15 steelhead DPSs, 2 are listed as endangered, 9 are listed as threatened, and 1 is an ESA species of concern (National Marine Fisheries Service 2010).

Puget Sound DPS

The Puget Sound steelhead DPS was listed as threatened on 11 May 2007 (72 FR 26722-26735). Critical habitat is proposed for the Puget Sound DPS. This DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations, in streams in the river basins of the Strait of Juan de Fuca and Puget Sound, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek, and the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks.

Upper Columbia River DPS
On 24 August 2009, the Upper Columbia River Steelhead DPS was listed as threatened (74 FR 42605-42606). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border, and six artificial propagation programs. The artificial propagation programs included are the Wenatchee River, Wells Hatchery in the Methow and Okanogan Rivers, Winthrop National Fish Hatchery, Omak Creek, and Ringold.

Middle Columbia River DPS
The Middle Columbia River Steelhead DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams from above the Wind River, Washington, and the Hood River, Oregon, upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River Basin, and seven artificial propagation programs. The seven artificial propagation programs included are Touchet River Endemic, Yakima River Kelt Reconditioning Program in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River, as well as Umatilla River, and Deschutes River.

Lower Columbia River DPS
On 5 January 2006, the Lower Columbia River Steelhead DPS was listed as threatened (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington, and the Willamette and Hood Rivers, Oregon, and 10 artificial propagation programs. The ten artificial propagation programs include Cowlitz Trout Hatchery in the Cispus, Upper Cowlitz, Lower Cowlitz, and Tilton Rivers; the Kalama River Wild winter and summer run, Clackamas Hatchery, Sandy Hatchery, and the Hood River Hatchery winter and summer run. Populations excluded from this DPS are in the upper Willamette River Basin above Willamette Falls, Oregon, and from the Little and Big White Salmon Rivers, Washington.

Upper Willamette River DPS
The Upper Willamette River DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River.

Snake River Basin DPS
The Snake River Basin Steelhead DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned anadromous steelhead populations below natural and manmade impassable barriers in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho, and six artificial propagation programs. These artificial propagation programs are Tucannon River, Dworshak National Fish Hatchery, Lolo Creek, North Fork Clearwater, East Fork Salmon River, and Little Sheep Creek/Imnaha River.

Northern California DPS
The Northern California Steelhead DPS was listed as threatened on 7 June 2000, and reaffirmed on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned populations of steelhead in California coastal river basins from Redwood Creek in

Humboldt County southward to the Russian River in Sonoma County. Two artificial propagation programs are also considered part of the DPS, and they are the Yager Creek Hatchery and the North Fork Gualala River Hatchery.

California Central Valley DPS
The California Central Valley Steelhead DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned populations of steelhead (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco Bay and San Pablo Bays and their tributaries.

Central California Coast DPS
The Central California Coast Steelhead DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned populations of steelhead (and their progeny) in streams from the Russian River to Aptos Creek, Santa Cruz County, California (inclusive). It also includes the drainages of San Francisco and San Pablo Bays.

South-Central California Coast DPS
The South-Central California Coast Steelhead DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned populations of steelhead (and their progeny) in streams from the Pajaro River (inclusive), located in Santa Cruz County, California, to, but not including, the Santa Maria River, California.

Southern California Coast DPS
The Southern California Coast Steelhead DPS was listed as threatened on 5 January 2006 (71 FR 834-862). Critical habitat has been designated for this DPS. This DPS includes all naturally spawned anadromous steelhead populations below natural and man-made impassable barriers in streams from the Santa Maria River, San Luis Obispo County, California (inclusive) to the U.S.-Mexico Border.

Population and Abundance

Most of the DPSs have a low abundance relative to historical levels, and there is widespread occurrence of hatchery fish in naturally spawning populations (Good et al. 2005; National Marine Fisheries Service 2010). NMFS has reported population sizes from individual DPSs, but because all of these units occur together while at sea, it is difficult to estimate the marine population numbers. Specific population numbers, based on freshwater returns, within each of the DPSs is found in Good et al. (2005).

Life History

Steelhead may exhibit either an anadromous lifestyle or they may spend their entire life in fresh water (McEwan and Jackson 1996). The name steelhead is used primarily for the anadromous form of this species. Steelhead exhibit one of the most complex suites of life-history traits of any species of Pacific salmonid. Unlike other salmonids, steelhead can spawn more than once (i.e., are iteroparous), whereas all other salmonids discussed here spawn once and then die (i.e., are semelparous). The anadromous steelhead may spend several years in fresh water before smoltification and up to 3 years in salt water before returning to spawn.

There is considerable variation in this life history pattern within the population. Steelhead can be divided into two basic reproductive types, based on the state of sexual maturity at the time of river entry and duration of spawning migration. The first is the stream-maturing (summer-run steelhead in the Pacific Northwest and northern California), which enters fresh water in a sexually immature

condition between May and October, and requires several months to mature and spawn. The second is the ocean-maturing type (winter-run steelhead in the Pacific Northwest and northern California) which enters fresh water between November and April, with well-developed gonads, and spawns shortly thereafter. Coastal streams are dominated by winter-run steelhead, whereas inland steelhead of the Columbia River Basin are almost exclusively summer-run steelhead (National Marine Fisheries Service 2012a).

Habitat and Geographic Range

The present distribution of steelhead extends from the Kamchatka Peninsula in Asia, east to Alaska, and south to Southern California, although the species' historical range extended at least to Mexico (Good et al. 2005).

Since spawning occurs exclusively in freshwater systems outside of the Study Area, spawning habitats are not described here. However, information on freshwater habitats and spawning areas can be found in Pacific Fishery Management Council (2000), Beauchamp et al. (1983) and Emmett et al. (1991).

Steelhead tend to move immediately offshore on entering the marine environment although, in general, steelhead tend to remain closer to shore than other Pacific salmon species (Beamish et al. 2005). They generally remain within the coastal waters of the California Current (Beamish et al. 2005; Quinn and Myers 2004).

Predator/Prey Interactions

Predators of steelhead include fish-eating birds, such as terns and cormorants, and pinnipeds, such as sea lions and harbor seals, especially within coastal areas (National Marine Fisheries Service 2010). Juveniles in fresh water feed mostly on zooplankton (small animals that drift in the water), while adults feed on aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes, including other juvenile salmon depending on whether they are inhabiting streams or the ocean (National Marine Fisheries Service 2010).

Migration

Steelhead spawning migrations occur throughout the year, with seasonal peaks of activity in summer and fall. In a given river basin, there may be one or more peaks in migration activity. Large rivers, such as the Columbia River, might have migrating adult steelhead at all times of the year. In the Study Area, the primary rivers that steelhead migrate into are the Columbia, Willamette, Klamath, and Rogue Rivers although some of these rivers contain considerable migration barriers such as dams.

Species-Specific Threats

There are many threats to the survival of the steelhead DPSs in the Study Area. Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of Pacific Northwest steelhead.

3.9.2.3.1.6 Bull Trout (*Salvenlinus confluentus*)

Occurrence in the Study Area

The Coastal Puget Sound Bull Trout ESU will occur in the offshore and Inland Waters portion of the Study Area (Table 3.9-1).

Status and Management

The bull trout is listed as threatened throughout the contiguous U.S. (U.S. Fish and Wildlife Service 2010). On 1 November 1999, the Coastal-Puget Sound Bull trout DPS was listed as threatened (64 FR 58910). The Coastal-Puget Sound bull trout DPS encompasses all Pacific Coast drainages within the United States north of the Columbia River in Washington, including those flowing into Puget Sound. This population is thought to contain the only anadromous forms of bull trout in the United States. Critical habitat for bull trout was established 30 September 2010 (Figure 3.9-3) (U.S. Fish and Wildlife Service 2010).

Population and Abundance

Bull trout populations are severely reduced throughout the Study Area and no longer occur in northern California. Bull trout have declined in overall range and numbers of fish. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. Bull trout generally occur as isolated sub-populations in headwater lakes or tributaries where migratory fish have been lost.

Life History

Bull trout are a native fish in western North America, inhabiting pristine cold-water streams. Unlike other salmonids, bull trout require colder water temperatures. They exhibit resident and migratory life history strategies throughout much of their current range. Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and mature. Migratory bull trout spawn in tributary streams where juveniles stay from 1 to 4 years before migrating to either a lake (adfluvial), river (fluvial), or in certain coastal areas to salt water (anadromous), where maturity is reached in one of the three habitats (Federal Register 1998).

There are four distinct types of bull trout: anadromous, adfluvial (migrating between lakes, rivers, or streams), fluvial (inhibiting a stream or river), and resident. Only the anadromous type migrates from fresh water habitats to ocean habitats.

Habitat and Geographic Range

The historic distribution of bull trout was throughout the Columbia River Basin, east to Montana south to northern California, and north to southeastern Alaska (U.S. Fish and Wildlife Service 1998). Currently, they are mainly found in upper tributary streams in Montana, Idaho, Oregon, and Washington (U.S. Fish and Wildlife Service 1998). Within the Study Area, they will be most likely to occur in the Inland Waters of Puget Sound.

Predator/Prey Interactions

Predators of bull trout include fish-eating birds and marine mammals when within coastal areas (O'Brien 2003). Juveniles in fresh water feed mostly on insects and plankton, while adults feed on other fish (U.S. Fish and Wildlife Service 1998).

Figure 3.9-3: Bull Trout Critical Habitat in the Northwest Training and Testing Study Area

Migration

Bull trout in the Study Area (Washington Coastal-Puget Sound population) spawn in rivers and streams, but rear their young in the ocean (U.S. Fish and Wildlife Service 2013). Some bull trout in marine habitats in Puget Sound may be sub adults that will forage in these areas. Dams and diversion structures impede or limit migration and impair downstream habitat. Both resident bull trout, and migratory forms, may be found together, and either form may produce offspring that exhibit either resident or migratory behavior. Resident bull trout complete their entire life cycle in the tributary or nearby streams in which they spawn and rear. Migratory bull trout, however, spawn in tributary streams and remain there as juveniles for 1–4 years before migrating to either a lake, river, or saltwater to live as subadults or to live as adults (U.S. Fish and Wildlife Service 2004).

Species-Specific Threats

There are many threats to the survival of bull trout DPSs found within the Study Area. Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of bull trout.

3.9.2.3.2 Rockfish Species

3.9.2.3.2.1 Bocaccio (*Sebastes paucispinis*)

Occurrence in the Study Area

Three partially isolated populations of bocaccio are thought to occur, one off the California coast, one in Puget Sound, and a Northern population off Washington and British Columbia. The DPS that was listed by NMFS as endangered on 27 July 2010 is the Puget Sound segment, which does occur in the Inland Waters of the Study Area (Table 3.9-1).

Status and Management

On 27 July 2010 the Puget Sound/Strait of Georgia DPS was listed as endangered under the ESA (74 FR 18516). On 6 August 2013 critical habitat was proposed for the Puget Sound/Strait of Georgia DPS (78 FR 47635). . The Pacific Fisheries Management Council recommended that NMFS eliminate all directed fishing for bocaccio in 2003. The only allowable catch are bocaccio taken as bycatch in other fisheries. To ensure that catch levels are not exceeded, restrictions include depth-based management to prohibit bottom trawls, limited entry of fixed gear, and limited open access fishing in the times and areas where bocaccio are expected to occur. Bocaccio have an 80 percent chance of no further declines in 100 years, and the species is expected to rebuild in approximately 170 years with the implementation of the management measures stated above (National Oceanic and Atmospheric Administration 2009a).

Population and Abundance

The primary reason for the overall population decline is overfishing that occurred prior to the late 1990s. A secondary factor is an adverse environmental regime that was associated with recruitment failures from 1989 to 1998. A very strong 1999 class and good recruitment is thought to be due to the end of overfishing in 1998 and a return to their pre-overfishing conditions for recruitment from ocean climate (National Oceanic and Atmospheric Administration 2009a). A new stock assessment in 2005 (MacCall 2005) indicated that the stock of bocaccio is in better condition than was thought in 2002 (MacCall 2002), and that long-term risk of further decline is low if fishery management plans are adhered to (National Oceanic and Atmospheric Administration 2009a).

Life History

Bocaccio and other rockfishes are unique among bony fishes in that the fertilization and embryo development is internal and they give birth to live larval young. Larval young are found in surface waters and may be distributed over a wide area extending several hundred miles (several hundred kilometers) offshore. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents. Approximately 50 percent of adult bocaccio mature in 4–6 years and may live as long as 50 years (National Marine Fisheries Service 2012g). They school with widow, yellowtail, vermillion, and speckled rockfishes (Love and York 2006) and occur in large aggregations under drifting kelp beds and over firm sand-mud bottoms.

Habitat and Geographic Range

Bocaccio are most common between 160 and 820 ft. (49 and 250 m) depth, but may be found as deep as 1,560 ft. (475 m). They range from Punta Blanca, Baja California, to the Gulf of Alaska off Krozoff and the Kodiak Islands. They are most common between Oregon and northern Baja California. In the Puget Sound, the highest concentrations of bocaccio are found south of Tacoma Narrows (National Marine Fisheries Service 2012g).

Predator/Prey Interactions

Predators of juvenile bocaccio include fish-eating birds, such as terns and cormorants. The main predators of adult bocaccio are pinnipeds, such as sea lions, harbor seals, and elephant seals, especially within coastal areas. Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, while juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of juvenile rockfish associated with kelp beds, rocky reefs, pinnacles, and sharp drop-offs (National Marine Fisheries Service 2012g).

Migration

No real migration is known for bocaccio. Adults generally move into deeper water as they increase in size and age and are usually found on rocky bottoms and outcrops. Juveniles and sub adults may be more common than adults in shallower water, and can be found with rocky reefs, kelp canopies, and artificial structures such as piers and oil platforms.

Species-Specific Threats

Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of Pacific Northwest bocaccio.

3.9.2.3.2.2 Canary Rockfish (*Sebastidae pinniger*)

Occurrence in the Study Area

Canary rockfish may be present in the offshore and Inland Waters of the Study Area. The Puget Sound/Georgia Basin DPS, listed as threatened, may occur in the Inland Waters of the Study Area (Table 3.9-1).

Status and Management

On 23 April 2009, NMFS proposed that the canary rockfish be listed as threatened under the ESA, and the DPS in the Puget Sound/Georgia Basin was listed on 28 April 2010. On 6 August 2013 critical habitat was proposed for the Puget Sound/Strait of Georgia DPS (78 FR 47635). In 2003, the retention of canary rockfish in Washington was banned because this species is slow growing, late to mature, and long-lived.

Managers reduced trip/bag limits, implemented spatial closures, and created new gear restrictions intended to reduce trawling in rocky shelf habitats and coincident catch of rockfish in shelf flatfish trawls. These restrictions have greatly decreased the commercial and recreational fishing opportunities of canary rockfish; therefore, recent removals have been primarily due to bycatch. Current management practices remain the same for the threatened DPS of canary rockfish in the Puget Sound/Georgia Strait area. Populations are expected to increase slowly over the next few years (Wallace and Cope 2011).

Population and Abundance

The canary rockfish population has declined since the early 1970s. The population size of age three and older canary rockfish in California was estimated to be approximately 4,700 tons in 1973; however, that decreased nearly 60 percent to 1,900 tons in 1998. The mean length of the canary rockfish has also declined 13 percent since 1980, which indicates the removal of larger, older fish from the population. In 1999, the entire canary rockfish resource off the entire U.S. West Coast was declared overfished. Most recent analysis of population trends indicate that the population has gradually increased since 2002 although the future of this trend is uncertain (Wallace and Cope 2011).

Life History

Canary rockfish and other rockfishes are unique among bony fishes in that the fertilization and embryo development of their young is internal and they give birth to live larval young. Fecundity in female canary rockfish ranges from 260,000 to 1.9 million eggs, which is considerably more than many other rockfish species. The larval young are found in surface waters and may be distributed over a wide area extending several hundred miles (several hundred kilometers) offshore.

Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents. Fifty percent of adult canary rockfish are mature at 14 in. (36 cm) total length, when they are about 5 to 6 years of age. They can live to be 75 years old (National Marine Fisheries Service 2012f).

Habitat and Geographic Range

Canary rockfish primarily inhabit waters 160 to 820 ft. (49 to 250 m) deep but may be found as deep as 1,400 ft. (427 m). Juveniles and sub adults tend to be more common than adults in shallow water and are associated with rocky reefs, kelp canopies, and artificial structures. As they increase in size and age, adults generally move into deeper water but usually have strong site fidelity to rocky bottoms and outcrops. Canary rockfish hover in loose groups just above the bottom of their rocky habitat and do not migrate. The species ranges between Punta Colnett, Baja California, and the western Gulf of Alaska.

Predator/Prey Interactions

Predation on canary rockfish is most severe during the pelagic larval and juvenile stages. Chinook salmon are a main predator of larval canary rockfish. Other predators of juveniles are other fishes, mammals, and seabirds. After the juveniles descend to their rocky bottom habitat as adults, they are much less vulnerable to predators.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, while juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of juvenile rockfish associated with kelp beds, rocky reefs, pinnacles, and sharp drop-offs (National Marine Fisheries Service 2012f).

Migration

Although larval rockfish are dispersed passively throughout Puget Sound and offshore habitat, as adults, canary rockfish do not migrate (National Marine Fisheries Service 2012f).

Species-Specific Threats

Canary rockfish are fished directly and are often caught as bycatch in other fisheries, such as the salmon fishery. Other threats include, but are not limited to, habitat degradation; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of canary rockfish.

3.9.2.3.2.3 Yelloweye Rockfish (*Sebastes ruberrimus*)

Occurrence in the Study Area

Yelloweye rockfish may be present in the offshore and Inland Waters of the Study Area. The Puget Sound/Georgia Basin DPS, listed as threatened, may occur in the Inland Waters of the Study Area (Table 3.9-1).

Status and Management

On 28 April 2010, Puget Sound/Georgia Basin DPS was listed as threatened under the ESA (75 FR 22276). On 6 August 2013 critical habitat was proposed for the Puget Sound/Strait of Georgia DPS (78 FR 47635). Because the species is slow growing, late to mature, and long-lived, recovery from threats will take many years, even if the threats are no longer affecting the species.

For management purposes in Alaska, the yelloweye are classified as a non-pelagic rockfish species. Under sport fishing regulations rockfish species are divided into two categories: pelagic and non-pelagic. Each group has specific bag limits and restrictions to account for the different characteristics of each species groups. Recreational fisheries involving yelloweye are managed by the State of Alaska both in state waters, and within the exclusive economic zone. Commercial fisheries are managed by the State of Alaska within state waters and by the North Pacific Fishery Management Council within the exclusive economic zone. In southeast Alaska, the State of Alaska manages the commercial yelloweye fishery as part of the federal demersal shelf rockfish assemblage with oversight from the north Pacific Fishery Management Council (Alaska Department of Fish and Game 2012). Managers have constrained catches by eliminating all retention of yelloweye rockfish in both commercial and recreational fisheries instituting broad spatial closures, and creating new gear restrictions intended to reduce trawling in rocky shelf habitats and the coincident catch of rockfish in shelf flatfish trawls (Taylor and Wetzel 2011).

Population and Abundance

From the mid-1970s to mid-1990s recreational catch and effort data suggests possible declines in yelloweye abundance. The number of angler trips increased substantially while there was a decline in the average number of rockfish caught per trip. This data suggests declines in the population over time when correlated together. Currently there is no survey data being collected for this species; however, few of these fish are caught by fishermen, which suggests low population abundance (National Marine Fisheries Service 2012h). California and Oregon have very similar estimates of spawning output at unexploited equilibrium, while Washington's spawning output is considerably lower. Relative depletion also varies by state, with California estimated to be at 17.3 percent of unexploited conditions, Oregon 23.9 percent, and Washington 27.2 percent (Taylor and Wetzel 2011).

Life History

Yelloweye rockfish and other rockfishes are unique among bony fishes in that the fertilization and embryo development of their young is internal and they give birth to live larval young. Fecundity in female yelloweye rockfish ranges from 1.2 to 2.7 million young. Yelloweye larval release occurs between February and September. The larval young are found in surface waters and may be distributed over a wide area extending several hundred miles (several hundred kilometers) offshore. Their survival is affected by ocean conditions such as temperature, currents, and the availability of food. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents. Approximately 50 percent of adult yelloweye rockfish are mature by 16 in. (41 cm) total length, which is about 6 years of age. Yelloweye rockfish are among the longest lived rockfishes and can live up to 118 years (National Marine Fisheries Service 2012h).

Habitat and Geographic Range

Yelloweye range from northern Baja California to the Aleutian Islands, Alaska, but are most common from Central California northward to the Gulf of Alaska. Juveniles and sub adults tend to be more common than adult fish in shallower water and are associated with rocky reefs, kelp canopies, and artificial structures. As yelloweye mature, they move to deeper water and increase in size, but usually exhibit strong site fidelity to rocky bottoms and outcrops. Yelloweye rockfish occur in waters 80–1,560 ft. (24–475 m), but are most commonly found between 300 and 590 ft. (91 and 180 m) (National Marine Fisheries Service 2012h). Adult yelloweye, like many species of non-pelagic rockfish, have small home ranges, and some of them may live their entire adult life on a single rock pile (Alaska Department of Fish and Game 2012).

Predator/Prey Interactions

Common predators of adult yelloweye include killer whales, seals, sharks, and dolphins. Juvenile yelloweye may be taken by birds, porpoises, and fishes such as other rockfish and lingcod. Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, while juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of juvenile rockfish associated with kelp beds, rocky reefs, pinnacles, and sharp drop-offs (National Marine Fisheries Service 2012h).

Migration

No real migration is known for adult yelloweye rockfish. Adult yelloweye, like many species of non-pelagic rockfish, have small home ranges, and some of them may live their entire adult life on a single rock pile (Alaska Department of Fish and Game 2012).

Species-Specific Threats

Non-pelagic rockfish, including the yelloweye, are extremely vulnerable to overfishing. Another contributing factor to the vulnerability of yelloweye is the lack of a vent on their swim bladder. Without venting, yelloweye brought up from depth can suffer injury as air in the swim bladder expands, which often leads to bulging eyes or the stomach protruding from the mouth, in addition to other unseen internal injuries. With an inflated swim bladder the yelloweye cannot submerge easily and if released are subject to predation while floating on the surface. Because of the low survival rates of released yelloweye, catch and release fishing is strongly discouraged (Alaska Department of Fish and Game 2012). More threats include, but are not limited to, bycatch; habitat degradation; channel alterations; water quality problems; non-native exotic fish and plants; and climate change. These threats pose a serious challenge to the persistence of Pacific Northwest and Alaskan yelloweye rockfish.

3.9.2.3.3 Other Species

3.9.2.3.3.1 Pacific Eulachon (*Thaleichthys pacificus*)

Occurrence in the Study Area

The southern DPS of Pacific eulachon may be present in the inland and offshore waters of the Study Area (see Table 3.9-1).

Status and Management

Of the two Pacific eulachon DPSs, one is listed as threatened (National Marine Fisheries Service 2012i). The southern DPS was listed as threatened on 18 March 2010 (75 FR 13012), and critical habitat for the southern DPS was designated on 20 October 2011 (76 FR 65324) (National Marine Fisheries Service 2012i). The southern DPS of Pacific eulachon has 16 specific designated areas as critical habitat within the states of California, Oregon, and Washington. The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 335 miles (mi.) (539 kilometers [km]) of habitat (National Oceanic and Atmospheric Administration 2011b).

Population and Abundance

Both of the DPSs have a low abundance relative to historical levels (National Marine Fisheries Service 2012i). Since all of the DPSs occur together while at sea, it is difficult to estimate the marine population numbers; however, specific population numbers are based on freshwater returns. NMFS reports that the median commercial catch in the Columbia River decreased nearly 98 percent between 1938 to 1992 and 1993 to 2006 (National Marine Fisheries Service 2012i).

Life History

Pacific eulachon hatch in freshwater streams. The larvae are carried downstream to the ocean where they dispersed by ocean currents. After 3–5 years they return to their home freshwater stream to spawn from the late winter through mid-spring. Most Pacific eulachon adults die after spawning. The major spawning runs for Pacific eulachon occur in the Columbia River.

Habitat and Geographic Range

The present distribution of Pacific eulachon extends from the southeastern Bering Sea to northern California (National Marine Fisheries Service 2012i). Since spawning occurs exclusively in freshwater systems outside of the Study Area, spawning habitats are not described here. However most of the Pacific eulachon are from the Columbia River Basin; few originate from other rivers in northern California and they are infrequently in the rivers and tributaries of Puget Sound (National Marine Fisheries Service 2012i). Designated critical habitat for the Pacific eulachon is mainly in the Columbia River and in a small portion of the Strait of Juan de Fuca in Puget Sound.

Predator/Prey Interactions

Predators of Pacific eulachon include fish-eating birds, sturgeon, Pacific halibut, and pinnipeds, such as sea lions and harbor seals, especially within coastal areas (Pacific States Marine Fisheries Commission 1996). Pacific eulachons feed primarily on plankton during all life stages (Pacific States Marine Fisheries Commission 1996).

Migration

Adult Pacific eulachon migrate from their ocean habitats to reach their freshwater spawning grounds in high elevation tributaries. In the Study Area, the primary rivers that Pacific eulachon migrate into are in the Columbia River Basin, even though there are considerable migration barriers such as dams.

Species-Specific Threats

Principle threats include, but are not limited to, alteration of stream flow patterns and habitat degradation; barriers to fish passages; channel alterations; water quality problems; non-native fish, invertebrates, and plants; and climate change. These threats pose a serious challenge to the persistence of Pacific eulachon.

3.9.2.3.3.2 Green Sturgeon (*Acipenser medirostris*)

Occurrence in the Study Area

Green sturgeons are present in the coastal waters of the Offshore Area and in the Inland Waters portion of the Study Area (Huff et al. 2012). Critical habitat for the southern DPS is located in the offshore and inland water portions of the Study Area (Figure 3.9-4).

Status and Management

The North American green sturgeon Southern DPS was listed by NMFS as a threatened species under the ESA on 7 April 2006 (71 FR 17757). Critical habitat was designated on 9 October 2009 (74 FR 52300). This DPS does not spawn in the Study Area; however, a portion of its critical habitat does overlap with the Study Area, and therefore its protection measures must be addressed.

Population and Abundance

Green sturgeon from the Klamath and Rogue rivers are similar to each other but distinct from fish from San Pablo Bay, based on preliminary studies. Green sturgeon commonly occur in the lower Columbia River (Oregon–Washington) and genetic samples taken there appear to be a mixture of the other populations (St. Pierre 2006). A recent study estimates that the primary concentration of green sturgeon is located in the coastal waters of Washington, Oregon, and Vancouver Island, and near the San Francisco and Monterey Bays (Huff et al. 2012). NMFS has determined that, based on genetic evidence of discreteness, there are two DPSs for green sturgeon. The northern population ranges from the Eel River, California, to at least the Rogue River, Oregon. The southern population is principally comprised of the Sacramento River spawning stock.

Green sturgeon have been observed northwest of Graves Harbor, AK, and south of Monterey Bay, CA, but have not been identified as belonging to either the Northern or Southern distinct population segment. The geographical area occupied by the southern population encompasses all of the area from the Bering Sea, AK, to Ensenada, Mexico. The areas outside of the United States cannot be designated as critical habitat (50 C.F.R. 424.12(h)); therefore, the geographical area considered is limited to areas from the Bering Sea, AK (excluding Canadian waters), to the U.S.-California/Mexico border (National Oceanic and Atmospheric Administration 2009b).

Their wide distribution, large numbers observed seasonally in some areas, and projections based on demographic rates suggest that total green sturgeon numbers are at least in the tens of thousands (Beamesderfer and Webb 2002). The largest known spawning stock of green sturgeon is that of the Klamath River and its tributary. The Klamath River population is estimated to number up to 66,000 individuals of which 3,000 would be mature adults. Actual numbers of spawning females in the Klamath were estimated at 760–1,500 females per year based on average harvest and total mortality rates (Beamesderfer and Webb 2002).

Based on a review of recent tagging studies, harvest analyses, and stock assessments from many locations, Beamesderfer and Webb (2002) estimated that the total adult and sub-adult population size of green sturgeon is within the range of 34,000 to 160,000 fish. Of these, greatest abundance was

recorded for the Columbia River estuary, and ocean and bay waters of Oregon and Washington (St. Pierre 2006).

Life History

Green sturgeons hatch in fresh water and spend about 1– 4 years in fresh and estuarine waters before widely dispersing into nearshore oceanic waters, bays, and estuaries. They remain there until they reach maturity at more than 15 years of age and over 4 ft. (1.3 m) in length. Adults return to fresh water to spawn beginning in late February and spawning occurs from April to June. Females produce 60,000–140,000 eggs. They are long-lived, slow-growing fish.

Habitat and Geographic Range

Green sturgeon utilize both freshwater and saltwater habitat. They spawn in deep pools, or “holes” in large, turbulent, freshwater river main steams. Eggs are likely broadcast over large cobble substrates, but range from clean sand to bedrock substrates so that spawning habitat preferences are unclear. Cold, clean water is important for proper embryonic development. The adult fish live in oceanic waters, bays, and estuaries when they are not spawning. Green sturgeon are known to forage in estuaries and bays ranging from San Francisco Bay to British Columbia. They are found along the west coast of Mexico, the United States, and Canada (Huff et al. 2012).They are also found in Eurasia and are the most broadly distributed, wide-ranging, and marine-oriented species within the sturgeon family.

The historical and current distribution of where this species spawns is unclear as the green sturgeon makes non-spawning movements into coastal lagoons and bays in the late summer to fall. Their original spawning distribution may have been reduced due to harvest and other anthropogenic effects. They are believed to spawn today in the Rogue River in Oregon, Klamath River Basin in Oregon, and the Sacramento River in California. Spawning is rare in the Oregon Umpqua River. Green sturgeon also appear to occasionally occupy the Eel River (National Oceanic and Atmospheric Administration 2012).

Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms (110 m) depth from Monterey Bay, CA (including the Bay), north to Cape Flattery, WA, including the Strait of Juan de Fuca, to the U.S. Canadian boundary; and the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) (50 Code of Federal Regulations Part 226) (Figure 3.9-4).

Migration

Green sturgeons are still found in large concentrations in coastal estuaries; however, their range in fresh water has been largely restricted due to dams. Historically they were observed hundreds of miles (hundreds of kilometers) upstream in the Sacramento and Columbia rivers, but are currently restricted in the Columbia River to the lower 37 mi. (60 km) downstream of the Bonneville Dam. Spawning is presently known to occur in only three rivers in North America, all of which are in the United States; the Rogue River in Oregon, and the Klamath and Sacramento river systems in California. Klamath and Rogue River populations appear to spawn within 260 mi. (160 km) of the ocean while the Sacramento population may travel over 200 mi. (320 km) upriver to spawn (St. Pierre 2006).

Figure 3.9-4: Green Sturgeon Critical Habitat in the Northwest Training and Testing Study Area

Species-Specific Threats

Threats to the green sturgeon species that contribute to their risk of extinction include the loss of spawning habitat; concentration of spawning into a single spawning river; entrainment or impingement by water project operations, dredging, power plant operations, or other in-water activities; bycatch of green sturgeon in other fisheries; and poor water quality conditions (Department of Commerce 2010). The main factor in the decline of the southern DPS of green sturgeon is the reduction of the spawning area to a limited section of the Sacramento River. Other threats to the DPS include: insufficient freshwater flow rates in spawning areas; contaminants (e.g., pesticides); bycatch of green sturgeon in other fisheries; potential poaching (for caviar); entrainment by water projects; influence of non-native species; small population size; impassable river barriers; and elevated water temperatures (National Oceanic and Atmospheric Administration 2012).

3.9.2.4 Federally Managed Fisheries

U.S. fisheries are managed within a framework of overlapping international, federal, state, interstate, and tribal authorities. Individual states and territories generally have jurisdiction over fisheries in marine waters within 3 nautical miles (nm) of their coast. Federal jurisdiction includes fisheries in marine waters inside the U.S. Exclusive Economic Zone, which encompasses the area from 3 nm to 200 nm offshore of any U.S. coastline (National Oceanic and Atmospheric Administration 1996).

The Magnuson-Stevens Fishery Conservation and Management Act and Sustainable Fisheries Act (see Section 3.0.1.1, Federal Statutes, for details) led to the formation of eight fishery management councils that share authority with the NMFS to manage and conserve the fisheries in federal waters. Essential Fish Habitat (EFH) is also identified and managed under this act. For analyses of impacts on those habitats included as EFH within the Study Area, refer to Sections 3.3 (Marine Habitats), 3.7 (Marine Vegetation), and 3.8 (Marine Invertebrates). Together with NMFS, the councils maintain fishery management plans for specific species or species groups to regulate commercial and recreational fishing within their geographic regions. There are two regional fishery management councils including the North Pacific Regional Fishery Management Council and the Pacific Regional Fishery Management Council within the Study Area.

Federally managed species of marine fishes are listed in Table 3.9-3. These species are considered, along with ESA-listed species and other taxonomic groupings, in the analysis of impacts in Section 3.9.3 (Environmental Consequences). The analysis of impacts on commercial and recreational fisheries is provided in Section 3.12 (Socioeconomic Resources). The analysis of impacts of fisheries in relation to Native American and Alaska Native Traditional uses are described in Section 3.11 (Native American and Alaska Native Traditional Resources).

3.9.2.5 Taxonomic Group Descriptions and Distribution

3.9.2.5.1 Jawless Fishes (Orders Myxiniformes and Petromyzontiformes)

Hagfishes (Myxiniformes) occur exclusively in marine habitats and are represented by 70 species worldwide within temperate marine locations. This group feeds on dead or dying fishes and has very limited external features often associated with fishes, such as fins and scales (Helfman et al. 1997). The members of this group are important scavengers that recycle nutrients back through the ecosystem. Lampreys (Petromyzontiformes) are represented by approximately 11 marine or saltwater/freshwater species distributed primarily throughout the temperate regions of the Northern Hemisphere. Lampreys typically are parasitic, feeding on other live fishes. The most striking feature of the lampreys is the oral disc mouth which they use to attach to other fishes and feed on their blood (Moyle and Cech 1996;

Nelson 2006). A lamprey can exhibit two life histories. Anadromous lampreys, one type, spend most of their adult lives in salt water and move to fresh water to spawn. The other type is a freshwater species that completes its life cycle entirely in fresh water (Mansfield 2004).

3.9.2.5.1.1 Offshore

Jawless fishes of the Orders Myxiniformes and Petromyzontiforme occur in the Offshore Area. They are typically found on the seafloor and in the water column at depths below 80 ft. (24.4 m). The Pacific lamprey (*Entosphenus tridentatus* formerly *Lampetra tridentata*) is an anadromous and parasitic jawless fish and is widely distributed along the Pacific coast of North America including the Offshore Area. Pacific lamprey spend 6 months to 3.5 years in the marine offshore environment and feed on host fish (U.S. Fish and Wildlife 2010).

Table 3.9-3: Federally Managed Fish Species within the Northwest Training and Testing Study Area

Pacific Regional Fishery Management Council	
Common Name	**Scientific Name**
Groundfish Management Unit Species	
Sharks and Skates	
Big skate	*Raja binoculata*
California skate	*Raja inornata*
Leopard shark	*Triakis semifasciata*
Longnose skate	*Raja rhina*
Soupfin shark	*Galeorhinus zyopterus*
Spiny dogfish	*Squalus acanthias*
Ratfish	
Ratfish	*Hydrolagus colliei*
Morids	
Finescale codling	*Antimora microlepis*
Grenadiers	
Pacific rattail	*Coryphaenoides acrolepis*
Roundfish	
Cabezon	*Scorpaenichthys marmoratus*
Kelp greenling	*Hexagrammos decagrammus*
Lingcod	*Ophiodon elongatus*
Pacific cod	*Gadus macrocephalus*
Pacific whiting (hake)	*Merluccius productus*
Sablefish	*Anoplopoma fimbria*
Rockfish[1]	
Aurora rockfish	*Sebastes aurora*
Bank rockfish	*Sebastes rufus*
Black rockfish	*Sebastes melanops*
Black and yellow rockfish	*Sebastes chrysomelas*
Blackgill rockfish	*Sebastes melanostomus*

Table 3.9-3: Federally Managed Fish Species within the Northwest Training and Testing Study Area, Pacific Regional Fishery Management Council (continued)

Pacific Regional Fishery Management Council	
Common Name	**Scientific Name**
Groundfish Management Unit Species (continued)	
Rockfish[1] (continued)	
Blue rockfish	*Sebastes mystinus*
Bocaccio	*Sebastes paucispinis*
Bronzespotted rockfish	*Sebastes gilli*
Brown rockfish	*Sebastes auriculatus*
Calico rockfish	*Sebastes dallii*
California scorpionfish	*Scorpaena gutatta*
Canary rockfish	*Sebastes pinniger*
Chameleon rockfish	*Sebastes phillipsi*
China rockfish	*Sebastes nebulosus*
Chilipepper	*Sebastes goodei*
Copper rockfish	*Sebastes caurinus*
Cowcod	*Sebastes levis*
Darkblotched rockfish	*Sebastes crameri*
Dusky rockfish	*Sebastes ciliatus*
Dwarf-red rockfish	*Sebastes rufinanus*
Flag rockfish	*Sebastes rubrivinctus*
Freckled rockfish	*Sebastes lentiginosus*
Gopher rockfish	*Sebastes carnatus*
Grass rockfish	*Sebastes rastrelliger*
Greenblotched rockfish	*Sebastes rosenblatti*
Greenspotted rockfish	*Sebastes chlorostictus*
Greenstriped rockfish	*Sebastes elongatus*
Halfbanded rockfish	*Sebastes semicinctus*
Harlequin rockfish	*Sebastes variegatus*
Honeycomb rockfish	*Sebastes umbrosus*
Kelp rockfish	*Sebastes atrovirens*
Longspine thornyhead	*Sebastolobus altivelis*
Mexican rockfish	*Sebastes macdonaldi*
Olive rockfish	*Sebastes serranoides*
Pink rockfish	*Sebastes eos*
Pinkrose rockfish	*Sebastes simulator*
Pygmy rockfish	*Sebastes wilsoni*
Pacific ocean perch	*Sebastes alutus*
Quillback rockfish	*Sebastes maliger*
Redbanded rockfish	*Sebastes babcocki*
Redstripe rockfish	*Sebastes proriger*
Rosethorn rockfish	*Sebastes helvomaculatus*

Table 3.9-3: Federally Managed Fish Species within the Northwest Training and Testing Study Area, Pacific Regional Fishery Management Council (continued)

Pacific Regional Fishery Management Council	
Common Name	**Scientific Name**
Groundfish Management Unit Species (continued)	
Rockfish[1] (continued)	
Rosy rockfish	*Sebastes rosaceus*
Rougheye rockfish	*Sebastes aleutianus*
Sharpchin rockfish	*Sebastes zacentrus*
Shortbelly rockfish	*Sebastes jordani*
Shortraker rockfish	*Sebastes borealis*
Shortspine thornyhead	*Sebastolobus alascanus*
Silvergray rockfish	*Sebastes brevispinis*
Speckled rockfish	*Sebastes ovalis*
Splitnose rockfish	*Sebastes diploproa*
Squarespot rockfish	*Sebastes hopkinsi*
Starry rockfish	*Sebastes constellatus*
Stripetail rockfish	*Sebastes saxicola*
Swordspine rockfish	*Sebastes ensifer*
Tiger rockfish	*Sebastes nigrocinctus*
Treefish	*Sebastes serriceps*
Vermilion rockfish	*Sebastes miniatus*
Widow rockfish	*Sebastes entomelas*
Yelloweye rockfish	*Sebastes ruberimus*
Yellowmouth rockfish	*Sebastes reedi*
Yellowtail rockfish	*Sebastes flavidus*
Flatfish	
Arrowtooth flounder (turbot)	*Atheresthes stomias*
Butter sole	*Isopsetta isolepis*
Curlfin sole	*Pleuronichthys decurrens*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
Flathead sole	*Hippoglossoides elassodon*
Pacific sanddab	*Citharichthys sordidus*
Petrale sole	*Eopsetta jordani*
Rex sole	*Glyptocephalus zachirus*
Rock sole	*Lepidopsetta bilineata*
Sand sole	*Psettichthys melanostictus*
Starry flounder	*Platichthys stellatus*
Coastal Pelagic Management Unit Species	
Pacific sardine	*Sardinops sagax*
Pacific (chub) mackerel	*Scomber japonicus*

Table 3.9-3: Federally Managed Fish Species within the Northwest Training and Testing Study Area, Pacific Regional Fishery Management Council (continued)

Pacific Regional Fishery Management Council	
Common Name	**Scientific Name**
Coastal Pelagic Management Unit Species (continued)	
Northern anchovy, central and northern subpopulations	*Engraulis mordax*
Jack mackerel	*Trachurus symmetricus*
Highly Migratory Species Management Unit Species	
Tunas	
North Pacific albacore	*Thunnus alalunga*
Yellowfin tuna	*Thunnus albacares*
Bigeye tuna	*Thunnus obesus*
Skipjack tuna	*Katsuwonus pelamis*
Pacific bluefin tuna	*Thunnus orientalis*
Sharks	
Common thresher shark	*Alopias vulpinus*
Pelagic thresher shark	*Alopias pelagicus*
Bigeye thresher shark	*Alopias superciliosus*
Shortfin mako or bonito shark	*Isurus oxyrinchus*
Blue shark	*Prionace glauca*
Billfish and Swordfish	
Striped marlin	*Tetrapturus audax*
Swordfish	*Xiphias gladius*
Other	
Dorado or dolphinfish	*Coryphaena hippurus*
Pacific Halibut Management Unit	
Pacific halibut	*Hippoglossus stenolepis*
Salmon Species Management Unit Species	
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
North Pacific Regional Fishery Management Council	
Common Name	**Scientific Name**
Salmon Fishery Management Unit Species (East Area)	
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
Pink salmon	*Oncorhynchus gorbuscha*
Sockeye salmon	*Oncorhynchus nerka*
Chum salmon	*Oncorhynchus keta*

[1] The category "rockfish" includes all genera and species of the family Scopaenidae, even if not listed, that occur in the Washington, Oregon, and California area. The Scopaenidae genera are *Sebastes*, *Scorpaena*, *Sebastolobus*, and *Scorpaenodes*.
Source: Pacific Fishery Management Council 2008, North Pacific Fishery Management Council 2012.

3.9.2.5.1.2 Inland Waters

Jawless fish typically dwell on the seafloor when found in the Inland Waters of the Study Area. They tend to be at depths below 80 ft. (24.4 m) and temperatures below 55 degrees Fahrenheit (°F) (13 degrees Celsius [°C]). The distribution and abundance of lampreys have been reduced by the construction of dams and diversions as well as degradation of spawning and maturing habitat upriver from Inland Waters such as the Puget Sound. Pacific lampreys return to fresh water primarily during spring and summer months. They often spend about 1 year in freshwater habitat before spawning, usually remaining under large substrates (e.g., large boulders, bedrock crevices) associated with low water velocities until the following spring, when they move to spawning areas (U.S. Fish and Wildlife 2010).

3.9.2.5.1.3 Western Behm Canal, Alaska

Jawless fishes occur in the seafloor habitats of the Western Behm Canal portion of the Study Area (Paxton and Eshmeyer 1994). They are typically found at depths greater than 80 ft. (24.4 m) and temperatures below 55°F (13°C). There are five species of lamprey found in Alaska. The Arctic lamprey (*Lampetra camtschatica*) are the most common lamprey in Alaska. Pacific lampreys (*L. tridentate*) are found along coastal areas and are anadromous. Alaskan brook lamprey (*L. alaskense*) are nonparasitic and found in streams, river basins, and some lakes. The American river lamprey (*L. ayresii*) are not very common in Alaska; however, they have been found in the Southeast region which is included in the study area. The western brook lampreys (*L. richardsoni*) are freshwater and nonparasitic species that are found sparsely distributed in the Western Behm Canal portion of the Study Area (Mansfield 2004).

3.9.2.5.2 Sharks, Rays, and Chimaeras (Class Chondrichthyes)

The cartilaginous (non-bony) marine fishes of the class Chondrichthyes are distributed throughout the world's oceans, occupying all areas of the water column. This group is mainly predatory and contains many of the apex predators found in the ocean (e.g., great white shark, mako shark, and tiger shark) (Helfman et al. 1997). The whale shark and basking shark are notable exceptions as filter-feeders. Sharks and rays have some unique features among marine fishes such as no swim bladder; protective toothlike scales; unique sensory systems (electroreception, mechanoreception); and some species bear live young in a variety of life history strategies (Moyle and Cech 1996). The subclass Elasmobranchii contains more than 850 marine species, including sharks, rays and skates, spread across nine orders (Nelson 2006). Very little is known about the subclass Holocephali, which contains 58 marine species of chimaeras (Nelson 2006).

3.9.2.5.2.1 Offshore

Sharks and rays are found in the Offshore Area (Paxton and Eshmeyer 1994). While most sharks occur in the water column, many rays occur on or near the seafloor. Chimaeras are cool-water marine fishes that can be found from the intertidal zone (16 to 33 ft. [5 to 10 m]) to depths between 260 and 8,500 ft. (79.2 and 2,590.8 m) (Nelson 2006).

3.9.2.5.2.2 Inland Waters

Sharks and rays are found in the Inland Waters section of the Study Area (Paxton and Eshmeyer 1994). While most sharks occur in the water column, many rays occur on or near the seafloor. Chimaeras are cool-water marine fishes that are found at depths between 260 and 8,500 ft. (79.2 and 2,590.8 m) (Nelson 2006). Two elasmobranch species, sixgill sharks and dogfish, are common in the Puget Sound. Although their populations have declined, these species are found in areas overlapping with the Inland Waters portion of the Study Area (Fowler et al. 2005).

3.9.2.5.2.3 Western Behm Canal, Alaska

Sharks and rays are found in the Western Behm Canal portion of the Study Area (Paxton and Eshmeyer 1994). While most sharks occur in the water column, many rays occur on or near the seafloor. Chimaeras are cool-water marine fishes that are found at depths between 260 and 8,500 ft. (79.2 and 2,590.8 m) (Nelson 2006). There are three species of sharks that are abundant in the Alaska portion of the Study Area including, the Pacific sleeper shark (*Somniosus pacificus)*, spiny dogfish (*Squalus suckleyi)*, and the salmon shark (*Lamna ditropis)*. Spiny dogfish have both local and migratory populations, while Pacific sleeper sharks are generally found as local populations that move vertically throughout the water column and salmon sharks are found in local coastal populations (Tribuzio et al. 2010).

3.9.2.5.3 Eels and Spiny Eels (Order Anguilliformes and Elopiformes)

These fishes have a unique larval stage called leptocephalus ("thin head"). During the larval stage of leptocephalus, these transparent, leaf-like, or ribbon-shaped, larvae drift on ocean currents, feeding on dissolved organic molecules until they develop to their next life history stage, eventually returning to the sea bed to shrink and firm up their bodies and take on the coloring of their juvenile or adult stages (Paxton and Eschmeyer 1994). Eels (Anguilliformes) have an elongated snakelike body. Most of the 780 eel species do not inhabit the deep ocean. Eels generally feed on other fishes or small bottom-dwelling invertebrates, but they also feed on larger organisms (Helfman et al. 1997). The fishes in the order Elopiformes include two distinct groups that exhibit very different forms: the bonefishes and the little-known spiny eels, elongated seafloor feeders of decaying organic matter in deep ocean areas (Paxton and Eshmeyer 1994).

3.9.2.5.3.1 Offshore

One species of Elopiforme, the spiny eel, occurs in deep ocean waters ranging from 400 to 16,000 ft. (121.9 to 4,876.8 m), and are likely found within the Offshore Area. Deep-water eels from the order Anguilliforme, such as sawtooth eels, deepsea gulper eels, and snipe eels may be found in the deep water portions of the Offshore Area. Larval forms of both orders may be found throughout the water column of the Offshore Area due to their free floating nature and the ocean currents that disperse them (Paxton and Eshmeyer 1994).

3.9.2.5.3.2 Inland Waters

Anguilliforme eels may be found in their larval stage throughout the water column of the Inland Waters portion of the Study Area due to their free floating nature and ocean currents (Paxton and Eshmeyer 1994). Adult anguillid eels are generally not found in the nearshore of the eastern Pacific and therefore are likely not present in the Inland Waters portion of the Study Area (Aoyama 2009).

3.9.2.5.3.3 Western Behm Canal, Alaska

Due to their free floating nature and ocean currents the larval stage of Anguilliformes may be found throughout the water column of Western Behm Canal. Their adult forms, however, are likely not present in the Western Behm Canal portion of the Study Area (Aoyama 2009).

3.9.2.5.4 Eulachon and Salmonids (Orders Argentiniformes, Osmeriformes, Esociformes, and Salmoniformes)

A distinguishing feature of this group of fishes is an adipose fin composed of fatty tissue on their backs. The deepwater eulachons of the order Argentiniformes differ from the true eulachons of the order Osmeriformes mostly by their preferred habitat (deepwater versus coastal). The true eulachons are found in large abundances within coastal areas throughout the Northern Hemisphere, while the

deepwater eulachons are limited mainly to deepwater regions of the world's oceans. Eulachons are an important forage fish for other marine organisms, including other fishes, birds, and marine mammals. The native distribution of Salmoniformes is restricted to the cold waters of the Northern Hemisphere. Most species of salmon spawn in fresh water and live in the sea; they are among the most thoroughly studied fish groups in the world. Salmoniformes include trout, char, salmon, and whitefish. The osmeriformes include northern smelts, icefishes, and graylings, whitebaits, galaxiids, and pelladillos. Esociforms are made up of pikes and their relatives, while argentiniformes include herring smelts and slickheads (Paxton and Eshmeyer 1994).

3.9.2.5.4.1 Offshore

The native distribution of Salmoniformes is restricted to the cold waters of the Northern Hemisphere. Pink, chum, and coho salmon all migrate through the offshore section of the Study Area, from the central and Western Behm Canal, British Columbia, and Washington State. Many steelhead trout from California, Washington and Oregon migrate through the offshore area to the Alaskan Peninsula as well, and will be found in this portion of the Study Area (National Marine Fisheries Service 2011). Argentiniformes, Osmeriformes, Esociformes, and Salmoniformes are all likely to occur in the offshore portion of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.4.2 Inland Waters

Salmons, trouts, and smelts are all likely to occur in the Inland Waters of the Study Area (Paxton and Eshmeyer 1994) on the surface, in the water column, and on the seafloor. During their transition from fresh water to salt water, juvenile salmon occupy nearshore ecosystems in the Inland Waters portion of the Study Area. Five species of Pacific salmon spawn and mature in Puget Sound. Juvenile Chinook and chum salmon make the most extensive use of nearshore habitats. There are 22 populations of Chinook salmon spawning within Puget Sound east of the Elwha River and two populations (consisting of eight sub-populations) of chum salmon spawning in Hood Canal and the eastern Strait of Juan de Fuca during the summer and early fall (termed summer chum). These species could be present throughout the Inland Waters of the Study Area (Fresh 2006).

3.9.2.5.4.3 Western Behm Canal, Alaska

Species such as salmons, trouts, smelts, and galaxiids are all likely to occur in the Western Behm Canal portion of the Study Area (Paxton and Eshmeyer 1994) on the surface, in the water column, and on the seafloor. Coho, Chinook, pink, sockeye and chum salmon are all common to the Western Behm Canal, Behm Canal, portion of the Study Area. Fresh water streams and estuaries provide important habitat for spawning salmon, and they also serve as nursery grounds for developing eggs, fry, and juveniles. The Behm Canal serves as a migratory pathway, and juvinile habitat for the coho, Chinook, pink, sockeye, and chum salmonids (Alaska Department of Fish and Game 2013).

3.9.2.5.5 Dragonfishes and Lanternfishes (Orders Stomiiformes and Myctophiformes)

The orders Stomiiformes and Myctophiformes comprise one of the largest groups of the world's deepwater fishes—more than 500 total species, many of which are not very well described in the scientific literature (Nelson 2006). The ecological role of many of these species is also not well understood (Helfman et al. 1997). These fishes are known for their unique body forms (e.g., slender bodies, or disc-like bodies, often possessing light-producing capabilities) and adaptations that likely present some advantages within the deepwater habitats in which they occur (e.g., large mouths, sharp teeth, and sensitive lateral line (sensory) systems) (Haedrich 1996; Koslow 1996; Marshall 1996; Rex and Etter 1998; Warrant and Locket 2004). Stomiiformes usually breed near their deep resting areas, and the

buoyant eggs float to the surface where they hatch and the young form part of the plankton (Paxton and Eshmeyer 1994).

3.9.2.5.5.1 Offshore

Dragonfishes and lanternfishes occur in deep ocean waters, ranging from 3,280 to 16,000 ft. (1,000 to 4,900 m), and sometimes make diurnal migrations to shallower regions in search of nutrients within the Offshore Area (Froese and Pauly 2010; Paxton and Eshmeyer 1994). The horned lanternsfish (*Diaphus splendidus*), is found in the Offshore Area between 1,180 and 2,360 ft. (375 and 750 m) during the day and between 125 and 710 ft. (40 and 225 m) at night (Froese and Pauly 2011).

3.9.2.5.5.2 Inland Waters

Dragonfishes and lanternfishes are found in the Inland Waters portion of the Study Area in the water column and on the seafloor at depths of 630 ft. (200 m) and below. Their larvae are found in the inland portion of the Study Area as part of plankton (Paxton and Eshmeyer 1994).

3.9.2.5.5.3 Western Behm Canal, Alaska

Overall the dragonfishes and lanternfishes are found in the Western Behm Canal portion of the Study Area in the water column and on the seafloor at depths of 630 ft. (200 m) and below. Their larvae are found in the Western Behm Canal portion of the Study Area as part of plankton (Paxton and Eshmeyer 1994).

3.9.2.5.6 Greeneyes, Lizardfishes, Lancetfishes, and Telescopefishes (Order Aulopiformes)

Fishes of the order Aulopiformes are a diverse group that possess both primitive (adipose [fatty] fin, rounded scales) and advanced (unique swim bladder and jawbone) features of marine fishes (Paxton and Eshmeyer 1994). They are common in estuarine and coastal waters as well as deep ocean waters. The lizardfishes (Synodontidae), Bombay ducks (Harpadontidae), and greeneyes (Chlorophthalmidae) primarily occur in coastal waters to the outer shelf, where they rest on the bottom and are well camouflaged with the substrate (Paxton and Eshmeyer 1994). Lancetfishes (Alepisauridae) are primarily mid-water column fishes, but can be found ranging from the surface to deep-waters. Telescopefishes are primarily found in deep waters 1,640 to 3,280 ft. (500 to 1,000 m), but can also be found at shallower depths and may approach the surface at night (Paxton and Eshmeyer 1994).

3.9.2.5.6.1 Offshore

In general greeneyes, lizardfishes, and lancetfishes occur in the coastal waters of the offshore Study Area. Telescopefishes occur in deep waters, from 1,640 to 3,280 ft. (500 to 1,000 m), and will be primarily associated with the Offshore Area (Paxton and Eshmeyer 1994).

3.9.2.5.6.2 Inland Waters

Telescopefishes occur primarily in deep waters 1,640 to 3,280 ft. (500 to 1,000 m). The Inland Waters portion of the Study Area does have some habitats in which this species may reside due to depth, but they also can also be found at shallower depths approaching the surface at night. In general greeneyes, lizardfishes, and lancetfishes occur in the Inland Waters of the Study Area on the seafloor and in the water column (Paxton and Eshmeyer 1994).

3.9.2.5.6.3 Western Behm Canal, Alaska

The fish from the order Aulopiformes occur in the Western Behm Canal portion of the Study Area on the seafloor and in the water column. Telescopefishes occur primarily in deep waters 1,640–3,280 ft. (500—1,000 m), and therefore may be scarce in this portion of the Study Area. However, telescopefishes can also be found at shallower depths and may approach the surface at night (Paxton and Eshmeyer 1994).

3.9.2.5.7 Cods and Cusk-eels (Orders Gadiformes and Ophidiiformes)

The cods and cusk-eels include over 900 species, some of which are target species of commercial fisheries. The cods, or groundfish, account for approximately half of the world's commercial fishery landings (Food and Agriculture Organization of the United Nations 2005). Gadiforms, such as cods, are almost exclusively marine fishes, and occupy seafloor habitats in temperate, arctic, and Antarctic regions.

The order Ophidiiformes includes cusk-eels and brotulas, which have long eel-like tapering bodies and are distributed in deepwater areas throughout tropical and temperate oceans. The characteristics of ophidiiforms are similar to those of the other deepwater groups. Other fishes of this order are also found in shallow waters on coral reefs. In addition, there are several cusk-eel species which are pelagic or found on the continental shelves and slopes.

3.9.2.5.7.1 Offshore

Cods are generally found near the seafloor and feed on bottom-dwelling organisms. Alaska cod are found throughout the offshore area. They are found mainly along the continental shelf and upper slopes where they form schools in the Offshore Area (Froese and Pauly 2011). Cusk-eels occur near the seafloor of the Offshore Area (Paxton and Eshmeyer 1994).

3.9.2.5.7.2 Inland Waters

Cusk-eels and cods are likely to occur near the seafloor, and in the water column of the Inland Waters portion of the Study Area. The red brotula (*Brosmophycis marginata*) is the largest member of the cuskeel family and inhabits rocky shores found in the Inland Waters portion of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.7.3 Western Behm Canal, Alaska

Polar and Arctic cod will be found in the Western Behm Canal portion of the Study Area. The largest member of the cuskeel family, the red brotula, is found on rocky shores such as those found in the Western Behm Canal portion of the Study Area (Froese and Pauly 2011). Cusk-eels and cods occur near the seafloor, and in the water column of the Western Behm Canal portion of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.8 Toadfishes and Anglerfishes (Orders Batrachoidiformes and Lophiiformes)

The toadfishes and anglerfishes include nearly 400 species. The order Batrachoidiformes includes only the toadfish family. Some species of toadfishes produce and detect sounds by vibrating the swim bladder. They spawn in and around bottom structures and invest a substantial amount of parental care by defending their nests (Moyle and Cech 1996; Paxton and Eshmeyer 1994). The order Lophiiformes includes all of the world's anglerfishes, goosefishes, frogfishes, batfishes, and deepwater anglerfishes—most of which occur in seafloor habitats of all oceans. Some deepwater anglerfish use highly modified "lures" to attract prey (Helfman et al. 1997; Koslow 1996). These fishes are also an important predator among the deepwater, seafloor habitats of the Study Area (Nelson 2006). The anglerfishes can be

broken into two groups: (1) those that dwell in the deep water (10 families) and (2) those that live on the bottom or attached to drifting seaweed in shallow water (5 families).

3.9.2.5.8.1 Offshore

In general, toadfishes may be found in the shallow to moderately deep portions of the coastal region in the Offshore Area. Anglerfishes are diverse and widespread throughout the deep sea habitat of the Pacific. They can be found from the shallow littoral zone to the abyssal depths of the ocean, and are present throughout the offshore section of the Study Area (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.8.2 Inland Waters

Toadfishes may be found in the shallow to moderately deep portions of the Inland Waters. Anglerfishes may be found in the Inland Waters portion of the Study Area, as they are known to inhabit environments from the shallow littoral zone to the abyssal depths of the ocean (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.8.3 Western Behm Canal, Alaska

Anglerfishes should rarely be present in the Western Behm Canal portion of the Study Area, and their presence would be limited to deep seafloor habitats. Toadfishes are known to dwell in shallow to moderately deep coastal waters, and may be present in the Western Behm Canal portion of the Study Area (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.9 Silversides and Flyingfish (Order Atheriniformes and Beloniformes)

Atherinidae is a large order that includes a wide variety of families including silversides. Beloniformes are close relatives of Atherinidae, and include flyingfish and Pacific saury (*Cololabis saira*). Fishes from these orders have tendencies toward internal fertilization, although many species in these orders are known egg-layers, more and more species are discovered to be internal fertilizers. Atherinids characteristically have flattened dorsums, pectoral fins inserted high on the sides and near the top of the gill opening, widely separated dorsal fins, cycloid scales, and a metallic silvery streak along their side, lending to their common name, that is silverside. Most silversides are small fishes, under 5 in. (125 millimeters [mm]) in length, but a few species, such as the jack smelt (Atherinopsis) and topsmelt (Atherinops) of the eastern Pacific may attain 20 in. (500 mm) or more and are important to fisheries. Silversides typically school by the thousands, and are also important food for other fish (Ethier and Starnes 1993). The Pacific saury is in the Beloniformes family, and feeds on small crustaceans as well as the eggs and larvae of other fishes. Pacific saurys produce eggs that are attached to one another and floating objects by filaments on the egg surface. This species is a highly migratory species with a range extending from Korea and Japan, eastward to the Gulf of Alaska, and South to Mexico (Froese and Pauly 2011).

3.9.2.5.9.1 Offshore

Pacific saury are just one species of the order Beloniforme that occurs in the Offshore Area. As adults, they are generally found near the surface and in schools. As juveniles they are associated with drifting seaweed near the sea surface (Froese and Pauly 2011). Another species from the Beloniformes that occurs in the Offshore Area is Bennett's flyingfish (*Cheilopogon pinnatibarbatus pinnatbarbatus*). This species usually occurs near land in cooler water, and will be found more often near the coastal region of the Offshore Area (Froese and Pauly 2011). Silversides are not likely to occur in the Offshore Area (Froese and Pauly 2011).

3.9.2.5.9.2 Inland Waters

Beloniformes are not likely to occur in the Inland Waters portion of the Study Area. Atheriniformes such as the topsmelt silverside (*Atherinops affinis*) are common to bays, muddy and rocky areas, kelp beds, and estuarine areas, and would be likely to occur in the Inland Waters portion of the Study Area. Jack silversides (*Atherinopsis californiensis*) may be found in the Inland Waters of the southern portion of the Study Area; however, they are not likely to occur in the Puget Sound portion of the Study Area (Froese and Pauly 2011).

3.9.2.5.9.3 Western Behm Canal, Alaska

Atheriniformes, such as topsmelt silversides and jack silversides, are not likely to be found in the Western Behm Canal portion of the Study Area, as they are generally not found that far north. The Pacific saury from the Beloniformes order may occur in the Western Behm Canal portion of the Study Area, on or near the surface of the water. Adult Pacific saury are generally found in offshore areas near the surface of the water; however, they may be found in the Western Behm Canal, as they are a highly migratory species (Froese and Pauly 2011).

3.9.2.5.10 Oarfishes, Squirrelfishes, and Dories (Orders Lampridiformes, Beryciformes, and Zeiformes)

There are only 19 species in the order Lampridiformes—the oarfishes. They exhibit diverse body shapes, and some have a protruding mouth which allows for suction feeding on plankton. Other species, including the crestfish, possess grasping teeth used to catch prey. They occur only in the mid-water column of the open ocean, but are rarely observed (Nelson 2006). Fishes in the order Beryciformes are primarily deepwater or nocturnal species, many of which are poorly described. There are a few shallow water exceptions, including squirrelfishes, which are distributed throughout reef systems in tropical and subtropical marine regions (Nelson 2006). Squirrelfishes are an important food source relied upon by some subsistence fishing communities (Froese and Pauly 2010). The fish possess specialized eyes and large mouths and primarily feed on bottom-dwelling crustaceans (Goatley and Bellwood 2009). General information on the biology, ecology, and behavior of the order Zeiformes, or dories, is limited. The order includes some very rare families, many containing only a single species (Paxton and Eshmeyer 1994). .

3.9.2.5.10.1 Offshore

Marine fish of the orders Lampridiformes, Beryciformes, and Zeiformes may occur in the Offshore Area. Lampridiformes such as king-of-the-salmon (*Trachipterus altivelis*) and opah (*Lampris guttatus*) may occur there (Froese and Pauly 2011). Of the order Beryciformes, both the common fangtooth (*Anoplogaster carnuta*), a widespread deepsea species that occurs below 6,560 ft. (2,000 m) in the Offshore Area, and the longwing spinyfin (*Diretmoides pauciradiatus*) are likely to occur in the Offshore Area (Paxton and Eshmeyer 1994). ,In addition, the oxeye oreo (*Allocyttus folletti*), order Zeiformes, is likely to occur in the Offshore Area (Froese and Pauly 2011).

3.9.2.5.10.2 Inland Waters

Squirrelfish are more common to the shallower Inland Waters than the others. Oxeye oreos (*Allocyttus folletti*) are not likely to occur in the Inland Waters portion of the Study Area. King-of-the-salmon may occur in Inland Waters as small individuals and juveniles are found throughout the water column and on the bottom in inshore areas. Opah are not likely to occur in the Inland Waters portion of the Study Area. The common fangtooth and longwing spinyfin are not likely to occur in the Inland Waters portion of the Study Area (Froese and Pauly 2011). Larval stages of Lampridiformes, Beryciformes, and Zeiformes are

likely to be found throughout the water column of the Inland Waters portion of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.10.3 Western Behm Canal, Alaska

The common fangtooth, longwing spinyfin, opah, dories, and oxeye oreos are not likely to occur in the Western Behm Canal portion of the Study Area (Paxton and Eshmeyer 1994; Froese and Pauly 2010). Squirrelfish are more common in the shallower waters than the others, and are more likely to be prolific in the Western Behm Canal portion of the Study Area. This group is commonly found on the surface, in the water column, and on the seafloor. The king-of-the-salmon is likely to occur in the water column or on the seafloor of the Western Behm Canal portion of the Study Area.

3.9.2.5.11 Pipefishes and Seahorses (Order Gasterosteiformes)

Gasterosteiformes include sticklebacks, pipefishes, and seahorses. Sticklebacks and pipefish are common within the Study Area. Most of these species are found in brackish water throughout the world (Nelson 2006) and occur in surface, water column, and seafloor habitats. Small mouths on a long snout and armorlike scales are characteristic of this group. As most of these species exhibit a high level of parental care (e.g., sticklebacks build nests), survival of young is high compared to most other fish species, so relatively few young need to be produced to sustain populations (Helfman et al. 1997).

3.9.2.5.11.1 Offshore

Tube-snouts (*Aulorhynchus flavidus*) may be found in the Offshore Area near the surface in dense schools (Froese and Pauly 2011). These pipefishes may be found sparsely distributed throughout the offshore section of the Study Area on or near the surface of the water (Paxton and Eshmeyer 1994). Offshore populations of ninespine sticklebacks (*Pungitius pungitius*) are found near shore and in open water over sandy bottoms. Three-spined sticklebacks (*Gasterosteus aculeatus aculeatus*) are associated with floating mats of seaweed as juveniles in the Offshore Area; however, as adults they move into inshore regions (Froese and Pauly 2011).

3.9.2.5.11.2 Inland Waters

From the order Gasterosteiformes, tube-snouts, three-spined sticklebacks, and ninespine sticklebacks, all occur in the Inland Waters portion of the Study Area (Froese and Pauly 2011; Moyle and Cech 1996; Paxton and Eshmeyer 1994). Tube-snouts are found in kelp beds, eelgrass, rocky areas, and over sandy bottoms in the Inland Waters portion of the Study Area. Ninespine sticklebacks move inshore to shallow water in the spring to spawn, then move offshore in the fall. The spawning sticklebacks build and guard nests constructed from plant material in the Inland Waters portion of the Study Area. Three-spined sticklebacks usually occur over mud or sand and build nests similar to the ninespined stickleback. The three-spined stickleback will occur in the Inland Waters portion of the Study Area (Froese and Pauly 2011).

3.9.2.5.11.3 Western Behm Canal, Alaska

Dense schools of tube-snouts may be found near the surface in the Western Behm Canal portion of the Study Area. Three-spined and ninespined sticklebacks may occur as adults in the rocky substrate habitats there and the juvenile form of the three-spined stickleback may occur in association with floating vegetation throughout the area (Froese and Pauly 2011; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.12 Scorpionfishes (Order Scorpaeniformes)

The order Scorpaeniformes is a diverse group of more than 1,400 marine species, all with bony plates or spines near the head. This group contains the scorpionfishes, waspfishes, rockfishes, velvetfishes, pigfishes, sea robins, gurnards, sculpins, snailfishes, and lumpfishes (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994). Many of these fishes are adapted for inhabiting the seafloor of the marine environment (e.g., modified pectoral fins or suction discs), where they feed on smaller crustaceans and fishes. Sea robins are capable of generating sounds with their swim bladders (Moyle and Cech 1996).

3.9.2.5.12.1 Offshore

Most of these fishes occur in depths less than 330 ft. (100 m), but others are found in deepwater habitat, down to 7,000 ft. (2,130 m). The deepest living scorpaenids are the idiotfishes (*Sebastolobus alascanus*), and are found throughout the deeper portions of the offshore segment of the Study Area. Rock cods, stonefishes, velvetfishes, sea robins, flatheads, sablefishes, skilfishes, greenlings, combfishes, and lingcod will be dispersed throughout the offshore region in the water column and on the seafloor of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.12.2 Inland Waters

Scorpionfishes are widely distributed at all depths in the Inland Waters of the Study Area. Most occur in depths less than 330 ft. (100 m) but others are found in deepwater habitat to 7,000 ft. (2,100 m). Sculpins are a large division of Scorpaeniformes and are found in shallow water to moderate depths and are dominant in tide pools. Some sculpin species live in fresh water. Sculpins, fatheads, and poachers are present in the Inland Waters section of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.12.3 Western Behm Canal, Alaska

Scorpionfishes are widely distributed at all depths in the Western Behm Canal portion of the Study Area. Most occur in depths less than 330 ft. (100 m), but others are found in deepwater habitat to 7,000 ft. (2,130 m). Scorpaenifomes such as sablefish (*Anoplopoma fimbria*), skilfish (*Erilepis zonifer*), greenlings (*Hexagrammidae*), combfish (*Coris picta*), and lingcod (*Ophiodon elongatus*) are likely to occur in the Western Behm Canal portion of the Study Area. Sculpins (*Cottoidea*), fatheads (*Pimephales promelas*), and poachers (*Agonidae*) may also be present in the Western Behm Canal portion of the Study Area (Paxton and Eshmeyer 1994).

3.9.2.5.13 Groupers and Seabasses (Family Serranidae)

The Serranidae are primarily nearshore marine fishes that support recreational and commercial fisheries. Most seabasses and groupers are nocturnal predators found primarily within reef systems. They generally possess large mouths and feed mostly on bottom-dwelling fishes and crustaceans (Goatley and Bellwood 2009). Some groupers and seabasses take advantage of feeding opportunities in the low-light conditions of twilight when counter-shaded fishes become conspicuous and easier for these predators to locate (Rickel and Genin 2005). Other groupers are active during the daytime and exhibit a variety of opportunistic predatory strategies, such as ambush (Wainwright and Richard 1995). This group occurs in all coastal waters of the Study Area, but is mostly concentrated, in depths less than 100 ft. (30 m) (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.13.1 Offshore

Groupers and seabasses are found in the water column and on the seafloor in the offshore portion of the Study Area. They are mostly concentrated at depths less than 100 ft. (30 m). The kelp bass (*Paralabrax clathratus*) is commonly found in the offshore region of the Study Area (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.13.2 Inland Waters

The Serranidae are primarily nearshore marine fishes that support recreational and commercial fisheries. They occur in the Inland Waters of the Study Area and are mostly concentrated in depths less than 100 ft. (30 m). Groupers from the subfamily Epinephelinae occur in the Inland Waters portion of the Study Area near the seafloor (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.13.3 Western Behm Canal, Alaska

Seabass and groupers are fished both recreationally and commercially in Alaskan waters of the Western Behm Canal portion of the Study Area. Both seabass and groupers from the family Serranidae occur in the Western Behm Canal portion of the Study Area and are mostly concentrated in depths less than 100 ft. (30 m) (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.14 Gobies and Blennies (Suborders Gobioidei, Blennioidei)

The seafloor-dwelling gobies (Gobioidei) include Gobiidae, the largest family of marine fishes, exhibit modified pelvic fins that allow them to adhere to varying bottom surfaces (Helfman et al. 1997; Nelson 2006). Fishes of the suborder Blennioidei primarily occupy the intertidal zones throughout the world, including the clinid blennies (*Malacoctanus tetranemus*) and the combtooth blennies (*Blenniidae*) (Mahon et al. 1998; Moyle and Cech 1996; Nelson 2006). Blennies and gobies primarily feed on detritus on the seafloor. These fishes occur in all coastal waters of the Study Area, but are mostly concentrated, and exhibit the most varieties, in depths less than 100 ft. (30 m) (Froese and Pauly 2010; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.14.1 Offshore

Most fish in the suborders dwell in depths less than 100 ft. (30 m). Some clingfishes (Gobioidei) may occupy the shallow sections of the offshore segment of the Study Area in association with kelp or other algae (Froese and Pauly 2011; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.14.2 Inland Waters

Blennies and gobies are likely found on the seafloor and in association with marine vegetation in the Inland Waters portion of the Study Area (Froese and Pauly 2011). The gobbies and blennies may also be found associated with rocky coastal reefs and shallow coastal areas (Paxton and Eshmeyer 1994). The northern clingfish (*Gobiesox maeandricus*) and the kelp clingfish (*Rimicola muscarum*) will be found in the Inland Waters portion of the Study Area in rocky intertidal regions associated with algae and kelp (Froese and Pauly 2011).

3.9.2.5.14.3 Western Behm Canal, Alaska

The waters of Western Behm Canal are outside of the species range for most of the fish from the Gobioidei and Blennioidei suborders. However, the northern clingfish (Gobioidei) is likely to occur in the

Western Behm Canal portion of the Study Area in rocky intertidal regions associated with algae and kelp (Froese and Pauly 2011; Moyle and Cech 1996; Paxton and Eshmeyer 1994).

3.9.2.5.15 Jacks, Tunas, Mackerels, and Billfishes (Families Carangidae, Scombridae, Xiphiidae, and Istiophoridae)

The suborder Scombroidei contains some of the most voracious open ocean predators: the jacks, mackerels, barracudas, billfishes, and tunas (Estrada et al. 2003; Sibert et al. 2006). Many jacks are known to feed nocturnally (Goatley and Bellwood 2009) and in the low-light conditions of twilight (Rickel and Genin 2005) by ambushing their prey (Sancho 2000). In the open ocean, highly migratory tunas, mackerels, and billfishes are extremely important fisheries; they account for approximately one-third of total annual worldwide catch, by weight, with tunas and swordfish as the most important species (Food and Agriculture Organization of the United Nations 2005, Macfadyen et al. 2009). One unique adaptation found in these fishes is ram ventilation (Wegner et al. 2006). Many fishes in this group have large-scale migrations that allow for feeding in highly productive areas, which vary by season (Pitcher 1995).

3.9.2.5.15.1 Offshore

Carangidae, Scombridae, Xiphiidae, and Istiophoridae, otherwise known as jacks, tunas, mackerels, and billfishes, may be found in the offshore section of the Study Area. These fish are commonly found near the surface or the upper portion of the water column. They are widely distributed throughout the pelagic region of the Offshore Area of the Study Area (Froese and Pauly 2010; Paxton and Eshmeyer 1994).

3.9.2.5.15.2 Inland Waters

Jacks, tunas, mackerels, and billfishes are generally pelagic and found in the upper portion of the water column. Although they are very rarely found within shallower Inland Waters portions of the Study Area, they may be found in deeper areas of the Inland Waters portion of the Study Area (Froese and Pauly 2010; Paxton and Eshmeyer 1994).

3.9.2.5.15.3 Western Behm Canal, Alaska

Jacks, tunas, mackerels, and billfishes may very rarely be found near the surface, or upper portion of the water column in the Western Behm Canal portion of the Study Area (Froese and Pauly 2010; Paxton and Eshmeyer 1994).

3.9.2.5.16 Flounders (Order Pleuronectiformes)

The order Pleuronectiformes includes flatfishes (flounders, dabs, soles, and tonguefishes) that are found in all marine seafloor habitats throughout the world (Nelson 2006). Fishes in this group have eyes on either the left side or the right side of the head as larvae mature and are not symmetrical like most other fishes (Saele et al. 2004). All flounder species are ambush predators, feeding mostly on other fishes and bottom-dwelling invertebrates (Drazen and Seibel 2007; Froese and Pauly 2010).

3.9.2.5.16.1 Offshore

This group is distributed throughout the Offshore Area, but is particularly concentrated in depths less than 330 ft. (100 m). Flounders will be most commonly found on the seafloor. They are usually associated with sandy bottoms and would be expected on the continental slope of the Offshore Area (Froese and Pauly 2010; Paxton and Eshmeyer 1994).

3.9.2.5.16.2 Inland Waters

These species of flounders are commonly distributed on sandy bottoms, and their larvae will most commonly be found in the Inland Waters portion of the Study Area (Froese and Pauly 2010; Paxton and Eshmeyer 1994). The nearshore waters of the Puget Sound contain an abundance of righteyed flounders such as the rock sole (*Lepidopsetta bilineata*), English sole (*Parophyrys vetulus*), starry flounder (*Platichthys stellatus*), and sand sole (*Psettichthys melanostictus*) (Washington Department of Fish and Wildlife 2013).

3.9.2.5.16.3 Western Behm Canal, Alaska

This group is distributed throughout the Western Behm Canal portion of the Study Area where it is concentrated at depths less than 330 ft. (100 m). Flounders and soles found in the Western Behm Canal portion of the Study Area are generally associated with sandy bottomed seafloor (Froese and Pauly 2010; Paxton and Eshmeyer 1994).

3.9.2.5.17 Ocean Sunfishes (Molas) (Order Tetraodontiformes)

The fishes in the order Tetraodontiformes are the most advanced group of modern bony fishes. This order includes ocean sunfishes. Like the flounders, this group exhibits body shapes unique among marine fishes, including modified spines or other structures advantageous in predator avoidance. The unique body shapes also require the use of a tail swimming style because some species lack the muscle structure and body shape of other fishes. Most of these fishes are active during the daytime and exhibit a variety of strategies for catching prey, such as ambushing (Wainwright and Richard 1995). The ocean sunfishes (*Mola* species) are the largest bony fish and the most prolific vertebrate species, with females producing more than 300 million eggs in a breeding season (Moyle and Cech 1996). The ocean sunfishes occur very close to the surface. They are slow swimming and feed on a variety of plankton, such as jellyfish, crustaceans, and fishes (Froese and Pauly 2010). Their only natural predators are sharks, orcas, and sea lions (Helfman et al. 1997).

3.9.2.5.17.1 Offshore

Tetraodontiformes occur in the open waters of the Offshore Area and are particularly concentrated in depths less than 330 ft. (100 m). Molas, or ocean sunfishes, can be found throughout the Offshore Area and are likely to be found basking in the sun at the sea surface (Froese and Pauly 2010; Paxton and Eshmeyer 1994).

3.9.2.5.17.2 Inland Waters

The ocean sunfish (*Mola mola*) may occur in surface waters of the Inland Waters portion of the Study Area; however, they are more often found in the offshore area and open waters (Froese and Pauly 2011).

3.9.2.5.17.3 Western Behm Canal, Alaska

Ocean sunfishes of the order Tetraodontiforme are not likely to occur in the Western Behm Canal portion of the Study Area. They may be found on the surface of the water or in the water column if they venture into the Western Behm Canal, but are generally open ocean fishes (Froese and Pauly 2011).

3.9.3 ENVIRONMENTAL CONSEQUENCES

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) potentially impact marine fishes known to occur within the Study

Area. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including number of activities and ordnance expended). The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to marine fish in the Study Area and analyzed below include the following:

- Acoustic (sonar and other active acoustic sources; underwater explosives; weapons firing, launch, and impact noise; vessel noise; and aircraft noise)
- Energy (electromagnetic devices)
- Physical disturbance and strike (vessel and in-water device strikes, military expended materials, and seafloor devices)
- Entanglement (fiber optic cables and guidance wires, decelerator/parachutes)
- Ingestion (munitions and military expended materials other than munitions)
- Secondary stressors

Each of these components was analyzed for potential impacts on fishes within the stressor categories defined in this section. The specific analysis of the training and testing activities considers these components within the context of geographic location and overlap of marine fish resources. Training activities are not proposed in the Western Behm Canal; therefore, only the Offshore Area and the Inland Waters will be analyzed under Training Activities. In addition to the analysis here, the details of all training and testing activities, stressors, components that cause the stressor, and geographic overlap within the Study Area are included in Chapter 2 (Description of Proposed Action and Alternatives).

3.9.3.1 Acoustic Stressors

The following sections analyze potential impacts on fish from proposed activities that involve acoustic stressors (non-impulse and impulse).

3.9.3.1.1 Analysis Background and Framework

This section is largely based on a technical report prepared for the Navy: *Effects of Mid- and High-Frequency Sonars on Fish* (Popper 2008). Additionally, Popper and Hastings (2009) provide a critical overview of some of the most recent research regarding potential effects of anthropogenic sound on fish.

Studies of the effects of human-generated sound on fish have been reviewed in numerous places (e.g., National Research Council 1994, 2003; Popper 2003; Popper et al. 2004; Hastings and Popper 2005; Popper 2008; Popper and Hastings 2009a, 2009b). Most investigations, however, have been in the gray literature (non-peer-reviewed reports—see Hastings and Popper 2005; Popper 2008; and Popper and Hastings 2009b for extensive critical reviews of this material). Studies have been published assessing the effect on fish of short-duration, high-intensity signals such as might be found near high-intensity sonar, pile driving, or seismic air guns. The investigators in such studies examined short-term effects that could result in death to the exposed fish, as well as hearing loss and long-term consequences (Doksæter et al. 2009; Govoni et al. 2003; McCauley et al. 2003; Popper et al. 2005, 2007).

Table 3.9-4: Stressors for Fish in the Northwest Training and Testing Study Area

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Acoustic Stressors							
Sonar and other active acoustic sources	Offshore Area	See Table 3.0-10					
	Inland Waters						
	W. Behm Canal						
Explosives	Offshore Area	378	0	502	148	502	164
	Inland Waters	4	0	42	0	42	0
	W. Behm Canal	0	0	0	0	0	0
Weapons firing, launch, and impact noise	Offshore Area	QUALITATIVE					
	Inland Waters						
	W. Behm Canal						
Activities including vessel noise	Offshore Area	996	37	1,088	138	1,088	162
	Inland Waters	4	337	28	582	28	640
	W. Behm Canal	0	28	0	60	0	83
Activities including aircraft noise	Offshore Area	3,826	2	6,471	74	6,471	84
	Inland Waters	124	2	127	20	127	25
	W. Behm Canal	0	0	0	0	0	0
Energy Stressors							
Activities including electromagnetic devices	Offshore Area	0	0	0	0	0	0
	Inland Waters	0	0	1	0	1	0
	W. Behm Canal	0	0	0	0	0	0
Physical Disturbance and Strike Stressors							
Activities including vessels	Offshore Area	996	37	1,096	138	1,096	162
	Inland Waters	4	337	28	582	28	640
	W. Behm Canal	0	28	0	60	0	83
Activities including in-water devices	Offshore Area	429	40	484	154	484	183
	Inland Waters	0	379	1	648	1	716
	W. Behm Canal	0	0	0	0	0	0
Military expended materials	Offshore Area	189,668	621	196,888	2,511	196,888	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Activities including seafloor devices	Offshore Area	0	5	0	6	0	7
	Inland Waters	2	210	16	225	16	239
	W. Behm Canal	0	0	0	5	0	15

Table 3.9-4: Stressors for Fish in the Northwest Training and Testing Study Area (continued)

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Entanglement Stressors							
Fiber optic cables and guidance wires	Offshore Area	2	16	0	20	0	24
	Inland Waters	0	105	1	122	1	133
	W. Behm Canal	0	0	0	0	0	0
Decelerator/parachutes	Offshore Area	8,382	17	8,382	1,229	8,382	1,351
	Inland Waters	0	4	0	4	0	5
	W. Behm Canal	0	0	0	0	0	0
Ingestions Stressors							
Military expended materials from munitions	Offshore Area	177,778	200	182,804	1,946	182,804	2,139
	Inland Waters	4	6	42	6	42	6
	W. Behm Canal	0	0	0	0	0	0
Military expended materials other than munitions	Offshore Area	11,890	421	9,084	565	9,084	625
	Inland Waters	4	440	43	511	43	562
	W. Behm Canal	0	0	0	0	0	0
Secondary Stressors							
Habitat (sediments and water quality; air quality)	Offshore Area	QUALITATIVE					
	Inland Waters						
	W. Behm Canal						

3.9.3.1.1.1 Direct Injury

Non-Impulse Sound Sources

Potential direct injuries from non-impulse sound sources, such as sonar, are unlikely because of the relatively lower peak pressures and slower rise times than potentially injurious sources such as explosives. Non-impulse sources also lack the strong shock wave such as that associated with an explosion. The theories of sonar induced acoustic resonance, bubble formation, neurotrauma, and lateral line system injury are discussed below, although these would likely occur only in fish very close to the sound source and are therefore unlikely to impact entire populations of fish or have an impact in a large area.

Two unpublished reports examined the effects of mid-frequency sonar-like signals (1.5–6.5 kHz) on larval and juvenile fish of several species (Jørgensen et al. 2005; Kvadsheim and Sevaldsen 2005). No studies have indicated any physiological damage to adult fish from mid-frequency active sonar. In the first study, Kvadsheim and Sevaldsen (2005) showed that intense sonar activities in herring spawning areas affected less than 0.3 percent of the total juvenile stock. The second study, Jørgensen et al. (2005) exposed larval and juvenile fish to various sounds in order to investigate potential effects on survival, development, and behavior. The study used herring (*Clupea harengus*) (standard lengths 0.75–2 in. [2–5 cm]), Atlantic cod (*Gadus morhua*) (standard length 0.75–2.4 in. [2–6 cm]), saithe (*Pollachius virens*) (1.6 in. [4 cm]), and spotted wolffish (*Anarhichas minor*) (1.6 in. [4 cm]) at different developmental stages. The researchers placed the fish in plastic bags 10 ft. (3 m) from the sound source and exposed

them to between four and 100 pulses of one-second duration of pure tones at 1.5, 4, and 6.5 kHz. Sound exposure performed at these frequencies, with sound simulating real sonar-signals, did not result in any significant direct mortality among the fish larvae or juveniles exposed, except for two (of a total of 42) experiments repeated on juvenile herring where significant mortality (20-30 percent) was observed. Among fish kept in tanks 1–4 weeks after sound exposure, no significant differences in mortality or growth related parameters (length, weight and condition) between exposed groups and unexposed groups were observed. Studies of organs and tissues from selected herring experiments did not reveal obvious differences between unexposed and exposed groups (Jorgensen et al. 2005).

These two groups were both composed of herring, a hearing specialist, and were tested with sound pressure levels of 189 dB re 1 µPa, which resulted in a post-exposure mortality of 20 to 30 percent. In the remaining 80 tests, there were no observed effects on behavior, growth (length and weight), or the survival of fish that were kept as long as 34 days post exposure. While statistically significant losses were documented in the two groups impacted, the researchers only tested that particular sound level once, so it is not known if this increased mortality was due to the level of the test signal or to other unknown factors.

Swim bladder resonance is a function of the size and geometry of the air cavity, depth of the fish, and frequency of the transmitted signal. Wavelengths associated with mid-frequency sounds are shorter than wavelengths associated with lower frequency sounds. It is the lower frequencies that are expected to produce swim bladder resonance in adult fishes. Resonance frequencies for juvenile fish are 1-8 kHz and can escalate physiological impact (Løvik and Hovem 1979; Kvadsheim and Sevaldsen 2005).

High sound pressure levels may cause bubbles to form from micronuclei in the blood stream or other tissues of animals, possibly causing embolism damage (Ketten 1998). Fish have small capillaries where these bubbles could be caught and lead to the rupturing of the capillaries and internal bleeding. It has also been speculated that this phenomena could also take place in the eyes of fish due to potentially high gas saturation within the fish's eye tissues (Popper and Hastings 2009a).

As reviewed in Popper and Hastings (2009b), Hastings (1990, 1995) found 'acoustic stunning' (loss of consciousness) in blue gouramis (*Trichogaster trichopterus*) following an 8-minute exposure to a 150 Hz pure tone with a peak sound pressure level (SPL) of 198 dB re 1 µPa. This species of fish has an air bubble in the mouth cavity directly adjacent to the animal's braincase that may have caused this injury. Hastings (1990, 1995) also found that goldfish exposed to two hours of continuous wave sound at 250 Hz with peak pressures of 204 dB re 1 µPa, and fathead minnows exposed to 0.5 hours of 150 Hz continuous wave sound at a peak level of 198 dB re 1 µPa did not survive.

The only study on the effect of exposure of the lateral line system to continuous wave sound (conducted on one freshwater species) suggests no effect on these sensory cells by intense pure tone signals (Hastings et al. 1996).

Explosions and Other Impulse Sound Sources

The greatest potential for direct, non-auditory tissue effects is primary blast injury and barotrauma following exposure to explosions. Primary blast injury refers to those injuries that result from the initial compression of a body exposed to a blast wave. Primary blast injury is usually limited to gas-containing structures (e.g., swim bladder) and the auditory system. Barotrauma refers to injuries caused when the swim bladder or other gas-filled structures vibrate in response to the signal, particularly if there is a relatively sharp rise-time and the walls of the structure strike near-by tissues and damage them.

An underwater explosion generates a shock wave that produces a sudden, intense change in local pressure as it passes through the water (U.S. Department of the Navy 1998, 2001a). Pressure waves extend to a greater distance than other forms of energy produced by the explosion (i.e., heat and light) and are therefore the most likely source of negative effects to marine life from underwater explosions (Craig 2001; Scripps Institution of Oceanography 2005; U.S. Department of the Navy 2006).

The shock wave from an underwater explosion is lethal to fish at close range (see Section 3.0.5.3.1.2, Explosives, for a discussion of ranges for mortality dependent on charge size), causing massive organ and tissue damage and internal bleeding (Keevin and Hempen 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin and Hempen 1997; Wright 1982). Additional factors include the current physical condition of the fish and the presence of a swim bladder. At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton and Finneran 2006; O'Keeffe 1984; O'Keeffe and Young 1984; Wiley et al. 1981; Yelverton et al. 1975). Species with gas-filled organs have higher mortality than those without them (Continental Shelf Associates Inc. 2004; Goertner et al. 1994).

Two aspects of the shock wave appear most responsible for injury and death to fish: the received peak pressure and the time required for the pressure to rise and decay (Dzwilewski and Fenton 2002). Higher peak pressure and abrupt rise and decay times are more likely to cause acute pathological effects (Wright and Hopky 1998). Rapidly oscillating pressure waves might rupture the kidney, liver, spleen, and sinus and cause venous hemorrhaging (Keevin and Hempen 1997). They can also generate bubbles in blood and other tissues, possibly causing embolism damage (Ketten 1998). Oscillating pressure waves might also burst gas-containing organs. The swim bladder, the gas-filled organ used by most fish to control buoyancy, is the primary site of damage from explosives (Wright 1982; Yelverton et al. 1975). Gas-filled swim bladders resonate at different frequencies than surrounding tissue and can be torn by rapid oscillation between high- and low-pressure waves. Swim bladders are a characteristic of many bony fish but are not present in sharks and rays.

Studies that have documented fish killed during planned underwater explosions indicate that most fish that die do so within one to four hours, and almost all die within a day (Hubbs and Rechnitzer 1952; Yelverton et al. 1975). Fitch and Young (1948) found that the type of fish killed changed when blasting was repeated at the same marine location within 24 hours of previous blasting. They observed that most fish killed on the second day were scavengers, presumably attracted by the victims of the previous day's blasts. However, fishes collected during these types of studies have mostly been recovered floating on the water's surface. Gitschlag et al. (2001) collected both floating fish and those that were sinking or lying on the bottom after explosive removal of nine oil platforms in the northern Gulf of Mexico. They found that 3 to 87 percent (46 percent average) of the specimens killed during a blast might float to the surface. Other impediments to accurately characterizing the magnitude of fish mortality included currents and winds that transported floating fishes out of the sampling area and predation by seabirds or other fishes.

There have been few studies of the impact of underwater explosions on early life stages of fishes (eggs, larvae, juveniles). Fitch and Young (1948) reported the demise of larval anchovies exposed to underwater blasts off California, and Nix and Chapman (1985) found that anchovy and eulachon larvae died following the detonation of buried charges. It has been suggested that impulse sounds, such as that produced by seismic airguns, may cause damage to the cells of the lateral line in fish larvae and fry when

in close proximity (15 ft. [5 m]) to the sound source (Booman et al. 1996).Similar to adult fishes, the presence of a swim bladder contributes to shock wave-induced internal damage in larval and juvenile fishes (Settle et al. 2002). Shock wave trauma to internal organs of larval pinfish and spot from shock waves was documented by Govoni et al. (2003). These were laboratory studies, however, and have not been verified in the field.

Interim criteria for injury of fish were discussed in Stadler and Woodbury (2009). The onset of physical injury would be expected if either the peak sound pressure level exceeds 206 dB re 1 µPa, or the cumulative sound exposure level, accumulated over all pile strikes generally occurring within a single day, exceeds 187 dB re 1 micropascal squared second (μPa^2-s) for fish two grams or larger, or 183 dB re 1 μPa^2-s for smaller fish (Stadler and Woodbury 2009). A more recent study by Halvorsen et al. (2011) used carefully controlled laboratory conditions to determine the level of pile driving sound that may cause a direct injury to the fish tissues (barotrauma). The investigators found that juvenile Chinook salmon (*Oncorhynchus tshawytscha*) received less than a single strike sound exposure level of 179 to 181 dB re 1µ Pa^2-s and cumulative sound exposure level of less than 211 dB re 1 μPa^2-s over the duration of the pile driving activity would sustain no more than mild, non-life-threatening injuries.

3.9.3.1.1.2 Hearing Loss

Exposure to high intensity sound can cause hearing loss, also known as a noise-induced threshold shift, or simply a threshold shift (Miller 1974). A temporary threshold shift (TTS) is a temporary, recoverable loss of hearing sensitivity. A TTS may last several minutes to several weeks and the duration may be related to the intensity of the sound source and the duration of the sound (including multiple exposures). A permanent threshold shift (PTS) is non-recoverable, results from the destruction of tissues within the auditory system, and can occur over a small range of frequencies related to the sound exposure. As with temporary threshold shift, the animal does not become deaf but requires a louder sound stimulus (relative to the amount of PTS) to detect a sound within the affected frequencies; however, in this case, the effect is permanent.

Permanent hearing loss, or permanent threshold shift has not been documented in fish. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cells loss is permanent (Lombarte et al. 1993; Smith et al. 2006). As a consequence, any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (e.g., Smith et al. 2006).

Non-Impulse Sound Sources

Studies of the effects of long-duration sounds with sound pressure levels below 170–180 dB re 1 µPa indicate that there is little to no effect of long-term exposure on species that lack notable anatomical hearing specialization (Amoser and Ladich 2003; Scholik and Yan 2001; Smith et al. 2004a, b; Wysocki et al. 2007). The longest of these studies exposed young rainbow trout (*Onorhynchus mykiss*), to a level of noise equivalent to one that fish would experience in an aquaculture facility (e.g., on the order of 150 dB re 1 µPa) for about 9 months. The investigators found no effect on hearing (i.e., TTS) as compared to fish raised at 110 dB re 1 µPa.

In contrast, studies on fish with hearing specializations (i.e., greater sensitivity to lower sound pressures and higher frequencies) have shown that there is some hearing loss after several days or weeks of exposure to increased background sounds, although the hearing loss seems to recover (e.g., Scholik and Yan 2002; Smith et al. 2006; Smith et al. 2004a). Smith et al. (2006; 2004b) exposed goldfish to noise at 170 dB re 1 µPa and found a clear relationship between the amount of hearing loss (TTS) and the

duration of exposure until maximum hearing loss occurred after 24 hours of exposure. A 10-minute exposure resulted in a 5 dB TTS, whereas a 3-week exposure resulted in a 28 dB TTS that took over 2 weeks to return to pre-exposure baseline levels (Smith et al. 2004a) (Note: recovery time not measured by investigators for shorter exposure durations).

Similarly, Wysocki and Ladich (2005) investigated the influence of noise exposure on the auditory sensitivity of two freshwater fish with notable hearing specializations, the goldfish and the lined Raphael catfish (*Platydoras costatus*), and on a freshwater fish without notable specializations, the pumpkinseed sunfish (*Lepomis gibbosus*). Baseline thresholds showed greatest hearing sensitivity around 0.5 kHz in the goldfish and catfish and at 0.1 kHz in the sunfish. For the goldfish and catfish, continuous white noise of approximately 130 dB re 1 µPa at 1 m resulted in a significant TTS of 23 to 44 dB. In contrast, the auditory thresholds in the sunfish declined by 7 to 11 dB. The duration of exposure and time to recovery was not addressed in this study. Scholik and Yan (2001) demonstrated TTS in fathead minnows (*Pimephales promelas*) after a 24-hour exposure to white noise (0.3–2.0 kHz) at 142 dB re 1 µPa that did not recover as long as 14 days post-exposure.

Studies have also examined the effects of the sound exposures from Surveillance Towed Array Sensor System Low-Frequency Active sonar on fish hearing (Kane et al. 2010; Popper et al. 2007). Hearing was measured both immediately post exposure and for several days thereafter. Maximum received sound pressure levels were 193 dB re 1 µPa for 324 or 628 seconds. Catfish and some specimens of rainbow trout showed 10-20 dB of hearing loss immediately after exposure to the low-frequency active sonar when compared to baseline and control animals; however, another group of rainbow trout showed no hearing loss. Recovery in trout took at least 48 hours, but studies were not completed. The different results between rainbow trout groups is difficult to understand, but may be due to developmental or genetic differences in the various groups of fish. Catfish hearing returned to, or close to, normal within about 24 hours after exposure to low-frequency active sonar. Furthermore, examination of the inner ears of the fish during necropsy (note: maximum time fish were held post exposure before sacrifice was 96 hours) revealed no differences from the control groups in cilliary bundles or other features indicative of hearing loss (Kane et al. 2010).

The study of mid-frequency active sonar by the same investigators also examined potential effects on fish hearing and the inner ear (Halvorsen et al. 2012; Kane et al. 2010). Out of the four species tested (rainbow trout, channel catfish, largemouth bass, and yellow perch) only one group of channel catfish, tested in December, showed any hearing loss after exposure to mid-frequency active sonar. The signal consisted of a 2 second (s) long, 2.8–3.8 kHz frequency sweep followed by a 3.3 kHz tone of 1 s duration. The stimulus was repeated five times with a 25 second interval. The maximum received sound pressure level was 210 dB re 1 µPa. These animals, which have the widest hearing range of any of the species tested, experienced approximately 10 dB of threshold shift that recovered within 24 hours. Channel catfish tested in October did not show any hearing loss. The investigators speculated that the difference in hearing loss between catfish groups might have been due to the difference in water temperature of the lake where all of the testing took place (Seneca Lake, New York) between October and December. Alternatively, the observed hearing loss differences between the two catfish groups might have been due to differences between the two stocks of fish (Halvorsen et al. 2012). Any effects on hearing in channel catfish due to sound exposure appear to be transient (Halvorsen et al. 2012; Kane et al. 2010). Investigators observed no damage to cilliary bundles or other features indicative of hearing loss in any of the other fish tested including the catfish tested in October (Kane et al. 2010).

Some studies have suggested that there may be some loss of sensory hair cells due to high intensity sources; however, none of these studies concurrently investigated effects on hearing. Enger (1981) found loss of cilliary bundles of the sensory cells in the inner ears of Atlantic cod following 1–5 hours of exposure to pure tone sounds between 50 and 400 Hz with a sound pressure level of 180 dB re 1 µPa. Hastings (1995) found auditory hair-cell damage in a species with notable anatomical hearing specializations, the goldfish (*Carassius auratus*) exposed to 250 Hz and 500 Hz continuous tones with maximum peak levels of 204 dB re 1 µPa and 197 dB re 1 µPa, respectively, for about 2 hours. Similarly, Hastings et al. (1996) demonstrated damage to some sensory hair cells in oscars (*Astronotus ocellatus*) following a 1-hour exposure to a pure tone at 300 Hz with a peak pressure level of 180 dB re 1 µPa. In none of the studies was the hair cell loss more than a relatively small percent (less than a maximum of 15 percent) of the total sensory hair cells in the hearing organs.

Explosions and Other Impulse Sound Sources

Popper et al. (2005) examined the effects of a seismic airgun array on a fish with hearing specializations, the lake chub (*Couesius plumbeus*), and two species that lack notable specializations, the northern pike (*Esox lucius*) and the broad whitefish (*Coregonus nasus*) (a salmonid). In this study the average received exposure levels were a mean peak pressure level of 207 dB re 1 µPa; sound pressure level of 197 dB re 1 µPa; and single-shot sound exposure level of 177 dB re 1 μPa^2-s. The results showed temporary hearing loss for both lake chub and northern pike to both 5 and 20 airgun shots, but not for the broad whitefish. Hearing loss was approximately 20 to 25 dB at some frequencies for both the northern pike and lake chub, and full recovery of hearing took place within 18 hours after sound exposure. Examination of the sensory surfaces of the ears by an expert on fish inner ear structure showed no damage to sensory hair cells in any of the fish from these exposures (Song et al. 2008).

McCauley et al. (2003) showed loss of a small percent of sensory hair cells in the inner ear of the pink snapper (*Pagrus auratus*) exposed to a moving airgun array for 1.5 hours. Maximum received levels exceeded 180 dB re 1 μPa^2-s for a few shots. The loss of sensory hair cells continued to increase for up to at least 58 days post exposure to 2.7 percent of the total cells. It is not known if this hair cell loss would result in hearing loss since fish have tens or even hundreds of thousands of sensory hair cells in the inner ear (Popper and Hoxter 1984; Lombarte and Popper 1994) and only a small portion were affected by the sound. The question remains as to why McCauley et al. (2003) found damage to sensory hair cells while Popper et al. (2005) did not. There are many differences between the studies, including species, precise sound source, and spectrum of the sound that it is hard to speculate.

Hastings et al. (2008) exposed the pinecone soldierfish (*Myripristis murdjan*), a fish with anatomical specializations to enhance their hearing; and three species without notable specializations: the blue green damselfish (*Chromis viridis*), the saber squirrelfish (*Sargocentron spiniferum*), and the bluestripe seaperch (*Lutjanus kasmira*) to an airgun array. Fish in cages in 16 ft. (4.9 m) of water were exposed to multiple airgun shots with a cumulative sound exposure level of 190 dB re 1 μPa^2-s. The authors found no hearing loss in any fish following exposures.

As with other impulse sound sources, it is assumed that sound from pile driving may cause hearing loss in fish located near the site (Popper and Hastings 2009c); however, there is a lack of research demonstrating this.

3.9.3.1.1.3 Auditory Masking

Auditory masking refers to the presence of a noise that interferes with a fish's ability to hear biologically relevant sounds. Fish use sounds to detect predators and prey, and for schooling, mating, and

navigating, among other uses (Myrberg 1980; Popper et al. 2003). Masking of sounds associated with these behaviors could have impacts to fish by reducing their ability to perform these biological functions.

Any noise (i.e., unwanted or irrelevant sound, often of an anthropogenic nature) detectable by a fish can prevent the fish from hearing biologically important sounds including those produced by prey or predators (Myrberg 1980; Popper et al. 2003). Auditory masking may take place whenever the noise level heard by a fish exceeds ambient noise levels, the animal's hearing threshold, and the level of a biologically relevant sound. Masking is found among all vertebrate groups, and the auditory system in all vertebrates, including fish, is capable of limiting the effects of masking noise, especially when the frequency range of the noise and biologically relevant signal differ (Fay 1988; Fay and Megela-Simmons 1999).

The frequency of the sound is an important consideration for fish because many marine fish are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005). The frequency of the acoustic stimuli must first be compared to the animal's known or suspected hearing sensitivity to establish if the animal can potentially detect the sound.

One of the problems with existing fish auditory masking data is that the bulk of the studies have been done with goldfish, a freshwater fish with well-developed anatomical specializations that enhance hearing abilities. The data on other species are much less extensive. As a result, less is known about masking in marine species, many of which lack the notable anatomical hearing specializations. However, Wysocki and Ladich (2005) suggest that ambient sound regimes may limit acoustic communication and orientation, especially in animals with notable hearing specializations.

Tavolga (1974a, b) studied the effects of noise on pure-tone detection in two species without notable anatomical hearing specializations, the pin fish (*Lagodon rhomboids*) and the African mouth-breeder (*Tilapia macrocephala*), and found that the masking effect was generally a linear function of masking level, independent of frequency. In addition, Buerkle (1968, 1969) studied five frequency bandwidths for Atlantic cod in the 20 to 340 Hz region and showed masking across all hearing ranges. Chapman and Hawkins (1973b) found that ambient noise at higher sea states in the ocean has masking effects in cod, *Gadus morhua (*L.), haddock, *Melanogrammus aeglefinus* (L.), and pollock, *Pollochinus pollachinus* (L.), and similar results were suggested for several sciaenid species by Ramcharitar and Popper (2004c).Thus, based on limited data, it appears that for fish, as for mammals, masking may be most problematic in the frequency region near the signal.

There have been a few field studies that may suggest masking could have an impact on wild fish. Gannon et al. (2005) showed that bottlenose dolphins (*Tursiops truncatus*) move toward acoustic playbacks of the vocalization of Gulf toadfish (*Opsanus beta*). Bottlenose dolphins employ a variety of vocalizations during social communication including low-frequency pops. Toadfish may be able to best detect the low-frequency pops since their hearing is best below 1 kHz, and there is some indication that toadfish have reduced levels of calling when bottlenose dolphins approach (Remage-Healey et al. 2006a). Silver perch have also been shown to decrease calls when exposed to playbacks of dolphin whistles mixed with other biological sounds (Luczkovich et al. 2000). Results of the Luczkovich et al. (2000) study, however, must be viewed with caution because it is not clear what sound may have elicited the silver perch response (Ramcharitar et al. 2006b). Astrup (1999) and Mann et al. (1998) hypothesized that high frequency detecting species (e.g., clupeids) may have developed sensitivity to

high frequency sounds to avoid predation by odontocetes. Therefore, the presence of masking noise may hinder a fish's ability to detect predators and therefore increase predation.

Of considerable concern is that human-generated sounds could mask the ability of fish to use communication sounds, especially when the fish are communicating over some distance. In effect, the masking sound may limit the distance over which fish can communicate, thereby having an impact on important components of their behavior. For example, the sciaenids, which are primarily inshore species, are one of the most active sound producers among fish, and the sounds produced by males are used to "call" females to breeding sights (Ramcharitar et al. 2001) reviewed in (2006b). If the females are not able to hear the reproductive sounds of the males, there could be a significant impact on the reproductive success of a population of sciaenids. Since most sound production in fish used for communication is generally below 500 Hz (Slabbekoorn et al. 2010a), sources with significant low-frequency acoustic energy could affect communication in fish.

Also potentially vulnerable to masking is navigation by larval fish, although the data to support such an idea are still exceedingly limited. There is indication that larvae of some reef fish (species not identified in study) may have the potential to navigate to juvenile and adult habitat by listening for sounds emitted from a reef (either due to animal sounds or non-biological sources such as surf action) (e.g., Higgs 2005). In a study of an Australian reef system, the sound signature emitted from fish choruses was between 0.8 and 1.6 kHz (Cato 1978) and could be detected by hydrophones 3–4 nm from the reef (McCauley and Cato 2000). This bandwidth is within the detectable bandwidth of adults and larvae of the few species of reef fish, such as the damselfish, *Pomacentrus partitus,* and bicolor damselfish, *Eupomacentrus partitus,* that have been studied (Kenyon 1996b; Myrberg 1980). At the same time, it has not been demonstrated conclusively that sound, or sound alone, is an attractant of larval fish to a reef, and the number of species tested has been very limited. Moreover, there is also evidence that larval fish may be using other kinds of sensory cues, such as chemical signals, instead of, or alongside of, sound (Atema et al. 2002).

3.9.3.1.1.4 Physiological Stress and Behavioral Reactions

As with masking, a fish must first be able to detect a sound above its hearing threshold for that particular frequency and the ambient noise before a behavioral reaction or physiological stress can occur. There are little data available on the behavioral reactions of fish, and almost no research conducted on any long-term behavioral effects or the potential cumulative effects from repeated exposures to loud sounds (Popper and Hastings 2009c).

Stress refers to biochemical and physiological responses to increases in background sound. The initial response to an acute stimulus is a rapid release of stress hormones into the circulatory system, which may cause other responses such as elevated heart rate and blood chemistry changes. Although an increase in background sound has been shown to cause stress in humans, only a limited number of studies have measured biochemical responses by fish to acoustic stress (Remage-Healey et al. 2006a; Smith et al. 2004b; Wysocki et al. 2007; Wysocki et al. 2006) and the results have varied. There is evidence that a sudden increase in sound pressure level or an increase in background noise levels can increase stress levels in fish (Popper and Hastings 2009c). Exposure to acoustic energy has been shown to cause a change in hormone levels (physiological stress) and altered behavior in some species such as the goldfish (*Carassius auratus*) (Pickering 1981; Smith et al. 2004a, b), but not all species tested to date, such as the rainbow trout (*Oncorhynchus mykiss*) (Wysocki et al. 2007).

Behavioral effects to fish could include disruption or alteration of natural activities such as swimming, schooling, feeding, breeding, and migrating. Sudden changes in sound level can cause fish to dive, rise,

or change swimming direction. There is a lack of studies that have investigated the behavioral reactions of unrestrained fish to anthropogenic sound, especially in the natural environment. Studies of caged fish have identified three basic behavioral reactions to sound: startle, alarm, and avoidance (McCauley et al. 2000; Pearson et al. 1992; Scripps Institution of Oceanography and Foundation. 2008). Changes in sound intensity may be more important to a fish's behavior than the maximum sound level. Sounds that fluctuate in level tend to elicit stronger responses from fish than even stronger sounds with a continuous level (Schwartz 1985).

Non-Impulse Sound Sources

Remage-Healey et al. (2006a) found elevated cortisol levels, a stress hormone, in Gulf toadfish exposed to low frequency bottlenose dolphin sounds. Additionally, the toadfish' call rates dropped by about 50 percent, presumably because the calls of the toadfish, a primary prey for bottlenose dolphins, give away the fish's location to the dolphin. The researchers observed none of these effects in toadfish exposed to an ambient control sound (i.e., low-frequency snapping shrimp 'pops').

Smith et al. (2004b) found no increase in corticosteroid, a stress hormone, in goldfish exposed to a continuous, band-limited noise (0.1 to 10 kHz) with a sound pressure level of 170 dB re 1 µPa for 1 month. Wysocki et al. (2007) exposed rainbow trout to continuous band-limited noise with a sound pressure level of about 150 dB re 1 µPa for 9 months with no observed stress effects. Growth rates and effects on the trout's immune system were not significantly different from control animals held at sound pressure level of 110 dB re 1 µPa.

Gearin et al. (2000) studied responses of adult sockeye salmon (*Oncorhynchus nerka*) and sturgeon (*Acipenser* sp.) to pinger sounds produced by acoustic devices designed to deter marine mammals from gillnet fisheries. The pingers produced sounds with broadband energy with peaks at 2 kHz or 20 kHz. They found that fish did not exhibit any reaction or behavior change to the pingers, which demonstrated that the alarm was either inaudible to the salmon and sturgeon, or that neither species was disturbed by the mid-frequency sound (Gearin et al. 2000). Based on hearing threshold data, it is highly likely that the salmonids did not hear the sounds.

Culik et al. (2001) did a very limited number of experiments to determine the catch rate of herring in the presence of pingers producing sounds that overlapped with the frequency range of hearing for herring (2.7 kHz to over 160 kHz). They found no change in catch rates in gill nets with or without the higher frequency (greater than 20 kHz) sounds present, although there was an increase in the catch rate with the signals from 2.7 kHz to 19 kHz (a different source than the higher frequency source). The results could mean that the fish did not "pay attention" to the higher frequency sound or that they did not hear it, but that lower frequency sounds may be attractive to fish. At the same time, it should be noted that there were no behavioral observations on the fish, and so how the fish actually responded when they detected the sound is not known.

Doksæter et al. (2009) studied the reactions of wild, overwintering herring to Royal Netherlands Navy experimental mid-frequency active sonar and killer whale feeding sounds. The behavior of the fish was monitored using upward looking echosounders. The received levels from the 1 to2 kHz and 6 to 7 kHz sonar signals ranged from 127 to 197 dB re 1 µPa and 139 to 209 dB re 1 µPa, respectively. Escape reactions were not observed upon the presentation of the mid-frequency active sonar signals; however, the playback of the killer whale sounds elicited an avoidance reaction. The authors concluded that mid-frequency sonar could be used in areas of overwintering herring without substantially affecting the fish.

There is evidence that elasmobranchs respond to human-generated sounds. Myrberg and colleagues did experiments in which they played back sounds and attracted a number of different shark species to the sound source (e.g., Myrberg et al. 1969; Myrberg et al. 1976; Myrberg et al. 1972; Nelson and Johnson 1972). The results of these studies showed that sharks were attracted to low-frequency sounds (below several hundred Hz), in the same frequency range of sounds that might be produced by struggling prey. However, sharks are not known to be attracted by continuous signals or higher frequencies (which they presumably cannot hear).

Studies documenting behavioral responses of fish to vessels show that Barents Sea capelin (*Mallotus villosus*) may exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jørgensen et al. 2004). Avoidance reactions are quite variable depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Misund (1997a) found that fish ahead of a ship that showed avoidance reactions did so at ranges of 160–490 ft. (48.8–149.4 m). When the vessel passed over them, some species of fish responded with sudden escape responses that included lateral avoidance or downward compression of the school.

In a study by Chapman and Hawkins (1973b) the low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses by herring. Avoidance ended within 10 seconds after the vessel departed. Twenty-five percent of the fish groups habituated to the sound of the large vessel and 75 percent of the responsive fish groups habituated to the sound of small boats.

Explosions and Other Impulse Sound Sources

Pearson et al. (1992) exposed several species of rockfish (*Sebastes spp.*) to a seismic airgun. The investigators placed the rockfish in field enclosures and observed the fish's behavior while firing the airgun at various distances for 10 minute trials. Dependent upon the species, rockfish exhibited startle or alarm reactions between peak to peak sound pressure level of 180 dB re 1 µPa and 205 dB re 1 µPa. The authors reported the general sound level where behavioral alterations became evident was at about 161 dB re 1 µPa for all species. During all of the observations, the initial behavioral responses only lasted for a few minutes, ceasing before the end of the 10-minute trial.

Similarly, Skalski et al. (1992) showed a 52 percent decrease in rockfish (*Sebastes* sp.) caught with hook-and-line (as part of the study—fisheries independent) when the area of catch was exposed to a single airgun emission at 186–191 dB re 1 µPa (mean peak level) (See also Pearson et al. 1987, 1992). They also demonstrated that fish would show a startle response to sounds as low as 160 dB re 1 µPa, but this level of sound did not appear to elicit decline in catch. Wright (1982) also observed changes in fish behavior as a result of the sound produced by an explosion, with effects intensified in areas of hard substrate.

Wardle et al. (2001) used a video system to examine the behaviors of fish and invertebrates on reefs in response to emissions from seismic airguns. The researchers carefully calibrated the airguns to have a peak level of 210 dB re 1 µPa at 16 m and 195 dB re 1 µPa at 109 m from the source. There was no indication of any observed damage to the marine organisms. They found no substantial or permanent changes in the behavior of the fish or invertebrates on the reef throughout the course of the study, and no marine organisms appeared to leave the reef.

Engås et al. (1996) and Engås and Løkkeborg (2002) examined movement of fish during and after a seismic airgun study by measuring catch rates of haddock (*Melanogrammus aeglefinus*) and Atlantic cod as an indicator of fish behavior using both trawls and long-lines as part of the experiment. These

investigators found a significant decline in catch of both species that lasted for several days after termination of airgun use. Catch rate subsequently returned to normal. The conclusion reached by the investigators was that the decline in catch rate resulted from the fish moving away from the airgun sounds at the fishing site. However, the investigators did not actually observe behavior, and it is possible that the fish just changed depth.

The same research group showed, more recently, parallel results for several additional pelagic species including blue whiting and Norwegian spring spawning herring (Slotte et al. 2004). However, unlike earlier studies from this group, the researchers used fishing sonar to observe behavior of the local fish schools. They reported that fish in the area of the airguns appeared to go to greater depths after the airgun exposure compared to their vertical position prior to the airgun usage. Moreover, the abundance of animals 18 to 31 miles (29 to 50 km) away from the ensonification increased, suggesting that migrating fish would not enter the zone of seismic activity.

Alteration in natural behavior patterns due to exposure to pile driving noise has not been well studied. However, one study (Mueller-Blenkle et al. 2010), which took place with fish enclosed in a mesocosm (an enclosure providing a limited body of water with close to natural conditions), demonstrated behavioral reactions of cod and Dover sole (*Solea solea*) to pile driving sounds. Sole showed a significant increase in swimming speed. Cod reacted, but not significantly, and both species showed directed movement away from the sources with signs of habituation after multiple exposures. For sole, reactions were seen with peak sound pressure levels of 144–156 dB re 1 µPa; and cod showed altered behavior at peak sound pressure levels of 140–161 dB re 1 µPa. For both species, this corresponds to a peak particle motion between 6.51×10^{-3} and 8.62×10^{-4} meters per second squared (m/s^2).

3.9.3.1.2 Impacts from Sonar and Other Active Acoustic Sources

Non-impulse sources from the Proposed Action include sonar and other active acoustic sources. Potential acoustic effects to fish from these sources may be considered in four categories, as detailed in Section 3.9.3.1.1 (Analysis Background and Framework): (1) direct injury; (2) hearing loss; (3) auditory masking; and (4) physiological stress and behavioral reactions.

As discussed in Section 3.9.3.1.1.1 (Direct Injury), direct injury to fish as a result of exposure to sonar is highly unlikely to occur. Therefore, direct injury as a result of exposure to sonar sources is not discussed further in this analysis.

Research discussed in Section 3.9.3.1.1.2 (Hearing Loss), indicates that exposure of fish to transient, non-impulse sources is unlikely to result in any hearing loss. Most sonar sources are outside of the hearing and sensitivity range of most marine fish, and noise sources such as vessel movement and aircraft overflight lack the duration and intensity to cause hearing loss. Furthermore, permanent hearing loss has not been demonstrated in fish as they have been shown to regenerate lost sensory hair cells. Therefore, hearing loss as a result of exposure to sonar and other active acoustic sources is not discussed further in this analysis.

3.9.3.1.2.1 No Action Alternative

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), training activities under the No Action Alternative include activities that produce in-water noise in the Offshore Area from the use of sonar and other active acoustic sources. Sonar and other active acoustic sources proposed for use are transient in most locations, as active sonar activities pass through the Study Area. Annual levels of sonar and other

active acoustic sources are shown for each source class (bin) in Table 3.0-10. The amounts in Table 3.0-10 are given for each alternative, and separated by training and testing.

High Frequency

Only a few species of shad within the Clupeidae family (herrings) are known to be able to detect high-frequency sonar and other active acoustic sources greater than 10,000 Hz. Other marine fish would not detect these sounds and would therefore experience no stress, behavioral disturbance, or auditory masking. Shad species, especially in nearshore and inland areas where mine warfare activities take place that often employ high-frequency sonar systems, could have behavioral reactions and experience auditory masking during these activities. However, mine warfare activities are typically limited in duration and geographic extent. Furthermore, sound from high-frequency systems may only be detectable above ambient noise regimes in these coastal habitats from within a few kilometers. Behavioral reactions and auditory masking, if they occurred for some shad species, are expected to be transient. Long-term consequences for the population would not be expected.

Mid Frequency

Most marine fish species are not expected to be able to detect sounds in the mid-frequency range of operational sonar. The fish species that are known to detect mid-frequencies (some sciaenids [drum], most clupeids [herring, sardines], and potentially deep-water fish such as myctophids [lanternfish]) do not have their best sensitivities in the range of operational sonar. Thus, these fish may only detect the most powerful systems, such as hull-mounted sonar, within a few kilometers, and most other, less powerful mid-frequency sonar systems, for a kilometer or less. Due to the limited time of exposure due to the moving sound sources, most mid-frequency active sonar used in the Study Area would not have the potential to substantially mask key environmental sounds or produce sustained physiological stress or behavioral reactions. Furthermore, although some species may be able to produce sound at higher frequencies (greater than 1 kHz), vocal marine fish, such as sciaenids, largely communicate below the range of mid-frequency levels used by most sonar. Other marine species probably cannot detect mid-frequency sonar (1,500 –10,000 Hz) and therefore impacts are not expected for these fish (Popper 2008). However, any such effects would be temporary and infrequent as a vessel operating mid-frequency sonar transits an area. Some mid-frequency active sonar use, outside the hearing range of most fish species, is proposed while ships are pierside and not transiting. As such, sonar use is unlikely to impact fish species. Long-term consequences for fish populations due to exposure to mid-frequency sonar and other active acoustic sources are not expected.

Low Frequency

A large number of marine fish species may be able to detect low-frequency sonar and other active acoustic sources. However, low-frequency active usage is rare and most low-frequency training activities are conducted in deeper waters, usually beyond the continental shelf break. The majority of fish species, including those that are the most highly vocal, exist on the continental shelf and within nearshore, estuarine areas. Fish within a few tens of kilometers around a low-frequency active sonar could experience brief periods of masking, physiological stress, and behavioral disturbance while the system is used, with effects most pronounced closer to the source. However, overall effects would be localized and infrequent.

Vessel Noise

As discussed in Section 3.0.5.3.1.4 (Vessel Noise), training activities under the No Action Alternative include vessel movement. Navy vessel traffic could occur anywhere within the Study Area; however, it would be concentrated near ports or naval installations and training ranges. Activities involving vessel

movements occur intermittently and are variable in duration, ranging from a few hours up to 2 weeks. Additionally, a variety of smaller craft would be operated within the Study Area. These small craft types, sizes, and speeds vary, but in general, they will emit higher-frequency noise than larger ships. Training and testing activities within the Study Area typically consist of a single vessel involved in unit-level activity for a few hours, or one or two small boats conducting testing. Navy vessels do contribute to the overall ambient noise in inland waters near Navy ports, although their contribution to the overall noise in these environments is minimal because these areas typically have large amounts of commercial and recreational vessel traffic.

A detailed description of vessel noise associated with the Proposed Action is provided in Section 3.0.5.3.1.4 (Vessel Noise). Vessel noise has the potential to expose fish to sound and general disturbance, which could result in short-term behavioral or physiological responses (e.g., avoidance, stress, increased heart rate). Training and testing activities involving vessel movements occur intermittently and range in duration from a few hours up to a few weeks. These activities are widely dispersed throughout the Study Area. While vessel movements have the potential to expose fish occupying the water column to sound and general disturbance, potentially resulting in short-term behavioral or physiological responses, such responses would not be expected to compromise the general health or condition of individual fish. In addition, most activities involving vessel movements are infrequent and widely dispersed throughout the Study Area. The exception is for pierside activities; although these areas are located in the Inland Waters, these are industrialized areas that are already exposed to high levels of anthropogenic noise due to numerous waterfront users (e.g., industrial and marinas). Therefore, impacts from vessel noise would be temporary and localized. Long-term consequences for the population are not expected.

Aircraft Noise

As described in Section 3.0.5.3.1.5 (Aircraft Overflight Noise), training activities under the No Action Alternative include fixed- and rotary-wing aircraft overflights. Certain portions of the Study Area, such as areas near Navy airfields, installations, and ranges are used more heavily by Navy aircraft than other portions. These activities would be spread across the coastal and open ocean areas designated within the Study Area. A detailed description of aircraft noise as a stressor is provided in Section 3.0.5.3.1.5 (Aircraft Overflight Noise). Aircraft produce extensive airborne noise from either turbofan or turbojet engines. A severe but infrequent type of aircraft noise is the sonic boom, produced when the aircraft exceeds the speed of sound. Rotary-wing aircraft (helicopters) produce low-frequency sound and vibration (Pepper et al. 2003).

Fish may be exposed to aircraft-generated noise wherever aircraft overflights occur; however, sound is primarily transferred into the water from air in a narrow cone under the aircraft (See Section G.2.1.6, Air-Water Interface, in Appendix G, Acoustic Primer). Most of these sounds would occur near airbases and fixed ranges within each range complex. Some species of fish could respond to noise associated with low-altitude aircraft overflights or to the surface disturbance created by downdrafts from helicopters. Aircraft overflights have the potential to affect surface waters and, therefore, to expose fish occupying those upper portions of the water column to sound and general disturbance, which could potentially result in short-term behavioral or physiological responses. If fish were to respond to aircraft overflights, only short-term behavioral or physiological reactions (e.g., swimming away and increased heart rate) would be expected. Therefore, long-term consequences for individuals would be unlikely and long-term consequences for the populations are not expected.

Training Activities

Offshore Area

The majority of fish species exposed to non-impulse sources would likely have no reaction or mild behavioral reactions. Overall, long-term consequences for individual fish are unlikely in most cases because acoustic exposures are intermittent and unlikely to repeat over short periods. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The ESA-listed salmonid species (steelhead trout, bull trout, Chinook salmon, Coho salmon, chum salmon, and sockeye salmon), green sturgeon, and Pacific eulachon, as summarized in Section 3.9.2.3, are anadromous and spend a portion of their lives in both the marine environment as well as in the riverine and estuarine systems throughout the Study Area. These species have the potential to be exposed to non-impulse sound associated with training activities under the No Action Alternative in the coastal areas of the Study Area. Since salmonid species and Pacific eulachon spawn in rivers and the early life stages of the fish occur in riverine and estuarine environments, eggs and larvae would not be exposed to sounds produced from non-impulse sound sources during training activities.

The ESA-listed DPSs of rockfish species (bocaccio, canary rockfish, yelloweye rockfish), as summarized in Section 3.9.2.3, spend their lives in the waters of Puget Sound. The juveniles and subadults of these species tend to favor shallow water habitats associated with kelp forests and rocky reefs, and the adults favor rocky bottoms in deeper waters. These species have the potential to be exposed to non-impulse sound associated with training activities under the No Action Alternative in the coastal areas of the offshore portions of the Study Area.

It is believed that salmonid species, which are anatomically similar to Atlantic salmon, are unable to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources (Section 3.9.2.1, Hearing and Vocalization). Therefore, acoustic impacts from these sources are not expected. Effects to designated critical habitat would not occur as activities do not overlap in the Offshore Area.

Low-frequency active sonar and other active acoustic sources are not typically operated in coastal or nearshore waters, where rockfish, Pacific eulachon, and green sturgeon are typically located. If low-frequency sources are used in these areas, then these species could be exposed to sound within their hearing range within these areas. If this did occur, these species could experience behavioral reactions, physiological stress, and auditory masking, although these impacts would be expected to be short-term and infrequent based on the low probability of co-occurrence between the activity and these species. Long-term consequences for the populations would not be expected.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose steelhead trout to sound and general disturbance, potentially resulting in short-term behavioral responses. However, as discussed above, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for populations are not expected.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), training activities under the No Action Alternative include activities that produce in-water noise from the use of sonar and other active acoustic

sources, and could occur throughout the Study Area. Sonar and other active acoustic sources proposed for use are transient in most locations as active sonar activities pass through the Study Area. A few activities involving sonar and other active acoustic sources occur in inshore water (within bays and estuaries), specifically at pierside locations.

The salmonid species, as summarized in Section 3.9.2, are anadromous and spend a portion of their lives in both the marine environment as well as in the riverine and estuarine systems. Similarly, the Pacific Eulachon and green sturgeon may occur in the Inland Waters. The rockfish species, as described in Section 3.9.2, are not migratory and will remain in the Inland Waters. Salmonid species, Pacific Eulachon, and the rockfish species have the potential to be exposed to non-impulse sound associated with training activities under the No Action Alternative in the Offshore Area.

Based on the lack of low-frequency sonar for training and the majority of sonar and other active acoustic sources that are outside the hearing range of most fish species, long-term consequences for fish populations are not expected. Effects to designated critical habitat would not occur as activities do not overlap in the Offshore Area.

Pursuant to the ESA, the use of sonar and other active acoustic sources during training activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of sonar and other active acoustic sources during training activities under the No Action Alternative would have no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

Testing Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 and 2.8-3, and in Section 3.0.5.3.1 (Acoustic Stressors), testing activities under the No Action Alternative include activities that use sonar and other active acoustic sources that produce underwater sound. Proposed testing activities under the No Action Alternative that involve sonar and other active acoustic sources differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernable from those described under the No Action Alternative – Training Activities.

Annual levels of testing sonar and other active acoustic sources for the No Action Alternative are shown for each source class (bin) in Table 3.0-10. Based on the low level and short duration of potential exposure to low-frequency sonar for testing and that the majority of sonar and other active acoustic sources would occur outside the hearing range of most fish species, long-term consequences for fish populations are not expected.

Offshore Area

Potential impacts to fish due to sonar and other active acoustic sources used in the Offshore Area are expected to be limited to short-term, minor behavioral reactions. Long-term consequences for populations would not be expected. Predicted impacts to ESA-listed species and any designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Inland Waters

Potential impacts to fish due to sonar and other active acoustic sources used in the Inland Waters are expected to be limited to short-term, minor behavioral reactions. Long-term consequences for populations would not be expected. Predicted impacts to ESA-listed species and any designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Western Behm Canal, Alaska

The majority of fish species exposed to non-impulse sources would likely have no reaction or mild behavioral reactions. Overall, long-term consequences for individual fish are unlikely in most cases because acoustic exposures are intermittent and unlikely to repeat over short periods. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area.

Therefore, acoustic impacts to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of sonar and other active acoustic sources during testing activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of sonar and other active acoustic sources during testing activities under the No Action Alternative would have no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

3.9.3.1.2.2 Alternative 1

Training Activities

Offshore Area

The number of annual training activities that produce in-water noise from the use of sonar and other active acoustic sources under Alternative 1 would increase from approximately 450 hours of use to 568 hours of use over the No Action Alternative, as indicated in Table 3.0-10 of Chapter 3 (Affected Environment and Environmental Consequences).

Despite the increase in activity, the potential effects of training activities involving sonar and other active acoustic sources under Alternative 1 on fish species would be similar to those described above for training activities under the No Action Alternative, and are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with training activities under Alternative 1. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1 and Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), the number of annual training activities that produce in-water noise from the use of sonar and other active acoustic sources under Alternative 1

would increase Training activities in the Inland Waters would increase to approximately 407 hours of in-water noise from the use of sonar and other active acoustic sources. The use of vessels would increase from 4 activities under the No Action Alternative to 28 under Alternative 1 (see Table 3.9-4). In comparison to the No Action Alternative, the increased use of sonar, vessels, and aircraft associated with training under Alternative 1 would increase the likelihood of exposure of fish to non-impulse underwater sounds.

The majority of fish species exposed to non-impulse sources would likely have no reaction or mild behavioral reactions. Overall, long-term consequences for individual fish are unlikely in most cases because acoustic exposures are intermittent and unlikely to repeat over short periods. Despite the increase in activity, the expected impacts to fish would be similar to the No Action Alternative. However, due to the increased exposure, there may be the potential for additional impacts. For the same reasons as stated above in No Action Alternative, impacts to fish are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with training activities under Alternative 1. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Pursuant to the ESA, the use of sonar and other active acoustic sources during training activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

The use of sonar and other active acoustic sources during training activities under Alternative 1 would have no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

Testing Activities

Offshore Area

Under Alternative 1, fish would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources during testing activities. Testing activities in the Offshore Area would increase to approximately 977 hours of in-water noise from the use of sonar and other active acoustic sources, and 943 items that produce in-water acoustic noise would be used. The use of vessels would increase, from 37 activities under the No Action Alternative to 138 under Alternative 1 (see Table 3.9-4).

Despite the increase in activity, the expected impacts to fish would be similar to the No Action Alternative. However, due to the increased exposure, there may be the potential for additional impacts. For the same reasons as stated above in No Action Alternative, impacts to fish are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with testing activities under Alternative 1. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 and 2.8-3, and Section 3.0.5.3.1 (Acoustic Stressors), the number of annual testing activities that produce in-water sound from the use of sonar and other active acoustic sources analyzed under Alternative 1 would increase over what was analyzed for the No Action Alternative. Testing activities in the Inland Waters would increase to approximately 5,448 hours of in-water noise from the use of sonar and other active acoustic sources, and 1,308 items that produce in-water acoustic noise would be used. The use of

vessels would increase from 337 activities under the No Action Alternative to 582 under Alternative 1 (see Table 3.9-4)The majority of fish species exposed to non-impulse sources would likely have no reaction or mild behavioral reactions. Overall, long-term consequences for individual fish are unlikely in most cases because acoustic exposures are intermittent and unlikely to repeat over short periods. In comparison to the No Action Alternative, the increased use of sonar, vessels, and aircraft associated with testing under Alternative 1 would increase the likelihood of exposure of fish species to non-impulse underwater sounds. The expected impacts to fish species would be similar to those described above for training activities under the No Action Alternative, and are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with testing activities under Alternative 1. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

Western Behm Canal, Alaska

Under Alternative 1, fish would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources during testing activities. Testing activities in the Western Behm Canal would result in approximately 2,762 hours of in-water noise from the use of sonar and other active acoustic sources. The use of vessels would increase from 28 activities under the No Action Alternative to 60 under Alternative 1 (see Table 3.9-4).

The majority of fish species exposed to non-impulse sources would likely have no reaction or mild behavioral reactions. Overall, long-term consequences for individual fish are unlikely in most cases because acoustic exposures are intermittent and unlikely to repeat over short periods. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, acoustic impacts to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of sonar and other active acoustic sources during testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

The use of sonar and other active acoustic sources during testing activities under Alternative 1 would have no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

3.9.3.1.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, fish would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources during training activities. Training activities in the Offshore Area would increase to approximately 551 hours of in-water noise from the use of sonar and other active acoustic sources, and 916 items that produce in-water acoustic noise would be used. The use of vessels would remain the same as under Alternative 1 (i.e., an increase from 996 under the No Action Alternative to 1,096 under Alternative 1 in the Offshore portion of the Study Area [see Table 3.9-4]).

Despite the increase in activity, the potential effects of training activities involving sonar and other active acoustic sources under Alternative 2 on fish species would be similar to those described above for training activities under the No Action Alternative, and are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with training activities under Alternative 2. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1 and Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), the number of annual training activities that produce in-water noise from the use of sonar and other active acoustic sources under Alternative 2 would increase. Training activities in the Inland Waters would increase to approximately 407 hours of in-water noise from the use of sonar and other active acoustic sources. The use of vessels would remain the same as under Alternative 1 (i.e., an increase from 4 activities under the No Action Alternative to 28 under Alternative 1 in the Inland Waters of the Study Area [see Table 3.9-4]). The only difference from Alternative 1 is the addition of the Civilian Port Defense exercise.

Despite the increase in activity, the potential effects of training activities involving sonar and other active acoustic sources under Alternative 2 on fish species would be similar to those described above for training activities under the No Action Alternative, and are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with training activities under Alternative 2. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Pursuant to the ESA, the use of sonar and other active acoustic sources during training activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of sonar and other active acoustic sources during training activities under Alternative 2 would have no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

Testing Activities

Offshore Area

Under Alternative 2, fish would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources during testing activities. The number of annual testing activities that produce in-water noise from the use of sonar and other active acoustic sources under Alternative 1 would increase. Testing activities in the Offshore Area would increase to approximately 1,073 hours of in-water noise from the use of sonar and other active acoustic sources, and 1,024 items that produce in-water acoustic noise would be used, for an increase of approximately 24 hours and 364 items under the No Action Alternative. The use of vessels would increase from 37 activities under the No Action Alternative to 162 under Alternative 1 (see Table 3.9-4). These activities would happen in the same general locations under Alternative 2 as described under Alternative 1.

In comparison to the No Action Alternative and Alternative 1, the increased use of sonar, vessels, and aircraft associated with testing under Alternative 2 would increase the likelihood of exposure of fish species to non-impulse underwater sounds. Despite the increase in activity, the potential effects of

testing activities involving sonar and other active acoustic sources under Alternative 2 on fish species would be similar to those described above for training activities under the No Action Alternative, and are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with testing activities under Alternative 2. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described under Alternative 1.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 and 2.8-3, and Section 3.0.5.3.1 (Acoustic Stressors), the number of annual testing activities that produce in-water sound from the use of sonar and other active acoustic sources analyzed under Alternative 2 would increase over what was analyzed for the No Action Alternative. Testing activities in the Inland Waters would increase to approximately 5,939 hours of in-water noise from the use of sonar and other active acoustic sources, and 1,410 items that produce in-water acoustic noise would be used. The use of vessels would increase from 337 activities under the No Action Alternative to 640 under Alternative 2 (Table 3.9-4). These activities would happen in the same general locations under Alternative 2 as described under the No Action Alternative – Training Activities.

Despite the increase in activity, the potential effects of testing activities involving sonar and other active acoustic sources under Alternative 2 on fish species would be similar to those described above for training activities under the No Action Alternative, and are expected to be limited to short-term, minor behavioral reactions. Effects to fish populations would not occur as a result of non-impulse sounds associated with testing activities under Alternative 2. Predicted impacts to ESA-listed species and designated critical habitat would not be discernable from those described in No Action Alternative – Training Activities.

Western Behm Canal, Alaska

Under Alternative 2, fish would be exposed to low-, mid-, and high-frequency sonar and other acoustic sources during testing activities. Testing activities in the Western Behm Canal would result in approximately 3,838 hours of in-water noise from the use of sonar and other active acoustic sources, an increase from 28 hours under the No Action Alternative. The use of vessels would increase from 28 activities under the No Action Alternative to 83 under Alternative 2 (Table 3.9-4).

The majority of fish species exposed to non-impulse sources would likely have no reaction or mild behavioral reactions. Overall, long-term consequences for individual fish are unlikely in most cases because acoustic exposures are intermittent and unlikely to repeat over short periods. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, acoustic impacts to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of sonar and other active acoustic sources during testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of sonar and other active acoustic sources during testing activities under Alternative 2 would have no effect on salmonid species, Pacific eulachon, or green sturgeon critical habitat.

3.9.3.1.3 Impacts from Explosives and Other Impulse Sound Sources

Explosions and other impulse sound sources include explosions from underwater detonations and explosive ordnance, and noise from weapons firing, launch, and impact with the water's surface. Potential acoustic effects to fish from impulse sound sources may be considered in four categories, as detailed in Section 3.9.3.1 (Acoustic Stressors) (1) direct injury; (2) hearing loss; (3) auditory masking; and (4) physiological stress and behavioral reactions.

The number of training events using explosives, weapons firing, launches, and non-explosive munitions and their proposed locations is presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). A discussion of explosives and the number of detonations in each source class is provided in Section 3.0.5.3.1.2 (Explosives). The types of noise produced during weapons firing, launches, and non-explosive munitions impact are discussed in Section 3.0.5.3.1.3 (Weapons Firing, Launch, and Impact Noise). Training activities involving explosions could be conducted throughout the Offshore Area, although activities do not normally occur within 3 nm of the shore.

Explosives

Concern about potential fish mortality associated with the use of at-sea explosives led military researchers to develop mathematical and computer models that predict safe ranges for fish and other animals from explosions of various sizes (e.g., Yelverton et al. 1975, Goertner 1982, Goertner et al. 1994). Young (1991) provides equations that allow estimation of the potential effect of underwater explosions on fish possessing swim bladders using a damage prediction method developed by Goertner (1982). Young's parameters include the size of the fish and its location relative to the explosive source, but are independent of environmental conditions (e.g., depth of fish and explosive shot frequency). An example of such model predictions is shown in Table 3.9-5, which lists estimated explosive effects ranges using Young's (1991) method for fish possessing swim bladders exposed to explosions that would typically occur during training exercises. The 10 percent mortality range is the distance beyond which 90 percent of the fish present would be expected to survive. It is difficult to predict the range of more subtle effects causing injury but not mortality (Continental Shelf Associates 2004).

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright 1982). Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation.

The number of fish killed by an underwater explosion would depend on the population density in the vicinity of the blast, as well as factors discussed above such as net explosive weight, depth of the explosion, and fish size. For example, if an explosion occurred in the middle of a dense school of menhaden, herring, or other schooling fish, a large number of fish could be killed. Furthermore, the probability of this occurring is low based on the patchy distribution of dense schooling fish.

Table 3.9-5: Estimated Explosive Effects Ranges for Fish with Swim Bladders

Training Operation and Type of Ordnance	Net Explosive Weight (lb.)	Depth of Explosion (ft.)	10% Mortality Range (ft.)		
			1 oz. Fish	1 lb. Fish	30 lb. Fish
Mine Neutralization					
MK 103 Charge	0.002	10	40	28	18
AMNS Charge	3.24	20	366	255	164
20 lb. NEW UNDET Charge	20	30	666	464	299
Missile Exercise					
Hellfire	8	3.3	317	221	142
Maverick	100	3.3	643	449	288
Firing Exercise					
HE Naval Gun Shell, 5-inch	8	1	244	170	109
Bombing Exercise					
MK 20	109.7	3.3	660	460	296
MK 82	192.2	3.3	772	539	346
MK 83	415.8	3.3	959	668	430
MK 84	945	3.3	1,206	841	541

Notes: AMNS = airborne mine neutralization system, HE = high-explosive, NEW = Net Explosive Weight, lb. = pound, ft. = foot/feet, oz. = ounce, UNDET = underwater detonation

Sounds from explosions could cause hearing loss in nearby fish (dependent upon charge size). Permanent hearing loss has not been demonstrated in fish, as lost sensory hair cells can be replaced unlike in mammals. However, fish that do experience hearing loss could miss opportunities to detect predators or prey, or reduce interspecific communication. If an individual fish were repeatedly exposed to sounds from underwater explosions that caused alterations in natural behavioral patterns or physiological stress, these impacts could lead to long-term consequences for the individual such as reduced survival, growth, or reproductive capacity. However, the time scale of individual explosions is very limited, and training exercises involving explosions are dispersed in space and time. Consequently, repeated exposure of individual fish to sounds from underwater explosions is not likely and most acoustic effects are expected to be short-term and localized. Long-term consequences for populations would not be expected.

There are no training or testing activities involving explosions or other impulse sound sources proposed in the Western Behm Canal portion of the Study Area under the No Action Alternative, Alternative 1, or Alternative 2. Therefore, Western Behm Canal is not included in this portion of the analysis.

3.9.3.1.3.1 No Action Alternative

Training

Offshore Area

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), training activities under the No Action Alternative would use underwater detonations and explosive ordnance.

Potential impacts on fish from explosions and impulse acoustic sources can range from no impact, brief acoustic effects, tactile perception, and physical discomfort; to slight injury to internal organs and the auditory system; to death of the animal (Keevin et al. 1997). Occasional behavioral reactions to

intermittent explosions and impulse acoustic sources are unlikely to cause long-term consequences for individual fish or populations.

Fish that experience hearing loss (permanent or temporary threshold shift) as a result of exposure to explosives and impulse acoustic sources may have a reduced ability to detect relevant sounds such as predators, prey, or social vocalizations. It is uncertain whether some permanent hearing loss over a part of a fish's hearing range would have long-term consequences for that individual. If this did affect the fitness of a few individuals, it is unlikely to have long-term consequences for the population.

It is possible for fish to be injured or killed by explosives; however, long-term consequences from a loss of a few individuals is unlikely to have measureable effects on overall stocks or populations. Therefore, long-term consequences to fish populations would not be expected.

The ESA-listed salmonid species (steelhead trout, Chinook salmon, chum salmon, coho salmon, sockeye salmon, and bull trout), green sturgeon, and Pacific eulachon, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), are anadromous and spend a portion of their lives in both the marine environment as well as in the riverine and estuarine systems. The rockfish species, as described in Section 3.9.2.3 (Endangered Species Act-Listed Species), are not migratory and will remain in the near shore areas of the Offshore Area. Salmonid species, Pacific Eulachon, and the rockfish species have the potential to be exposed to explosive energy and sound associated with training activities under the No Action Alternative in the Offshore Area. Since the salmonid species, Pacific eulachon, and green sturgeon spawn in rivers and the early lifestages of the fish occur in riverine and estuarine environments, eggs and larvae would not be exposed to impulse acoustic sources produced by explosives, weapons firing, launch, and non-explosive ordnance impact with the water's surface during training activities in the Offshore Area.

Training activities involving impulse acoustic sources in Offshore Area have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources, the likelihood of these species encountering an explosive activity taking place anywhere within Offshore Area is remote. Effects to chum, Chinook, and bull trout designated critical habitat would not occur as activities do not overlap. There is the potential for effects to green sturgeon designated critical habitat; however, it is unlikely that training activities involving impulse acoustic sources would occur that close to shore in the Offshore Area.

Inland Waters

Under the No Action Alternative, fish species would be exposed to explosions at or beneath the water during training activities. Noise could be produced by explosions and weapons firing in the Inland Waters of the Study Area.

Explosive events under the No Action Alternative would consist of a single explosion. Some marine fish close to a detonation would likely be killed, injured, damaged, or displaced. The detonations would occur in Hood Canal and Crescent Harbor. Training activities involving impulse acoustic sources in the Inland Waters have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources, the likelihood of these species encountering an explosive activity taking place in the Inland Waters is remote. There is the potential for effects to coho and Chinook designated critical habitat; however, it is unlikely that training activities

involving impulse acoustic sources would occur in designated portions of the Inland Waters away from the critical habitat.

Pursuant to the ESA, the use of explosives during training activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of explosives during training activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for chum, Chinook, and green sturgeon; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon critical habitat.

Testing Activities

Under the No Action Alternative, no testing activities involving explosives would occur in the Offshore Area, Inland Waters, or the Western Behm Canal, Alaska. Therefore, fish would not be exposed to explosions during testing activities.

Pursuant to the ESA, the use of explosives during testing activities under the No Action Alternative would have no effect on ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of explosives during testing activities under the No Action Alternative would have no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon critical habitat.

3.9.3.1.3.2 Alternative 1

Training Activities

Offshore Area

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), the number of annual training activities that use explosions under Alternative 1 would increase, due to an increase in the Gunnery Exercises (GUNEX), even though the SINKEX is removed. Although the number of explosives used in training activities would increase by about 39 percent compared to training activities under the No Action Alternative, these activities would generally occur in the same areas as under the No Action Alternative, and severity of impacts would not be discernable from those described in No Action Alternative – Training Activities.

As discussed for the No Action Alternative, potential impacts on fish from explosions and impulse sound sources can range from no effect, brief acoustic effects, tactile perception, and physical discomfort, to slight injury to internal organs and the auditory system, to death of the animal (Keevin and Hempen 1997). Occasional behavioral reactions to intermittent explosions and impulse sound sources are unlikely to cause long-term consequences for individual fish or populations. It is possible for fish to be injured or killed by explosives; however, long-term consequences from a loss of a few individuals is unlikely to have measureable effects on overall stocks or populations. Therefore, despite the increase in activities under Alternative 1, impacts from at-sea explosion from training activities would be temporary and localized since the activities are infrequent and widely dispersed throughout the Study Area, and the distribution of potentially affected fishes also varies.

Training activities involving impulse acoustic sources in Offshore Area have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources, the likelihood of these species encountering an explosive activity taking place

anywhere within Offshore Area is remote. Effects to chum, Chinook, and bull trout designated critical habitat would not occur as activities do not overlap. There is the potential for effects to green sturgeon designated critical habitat; however, it is unlikely since training activities involving impulse acoustic sources are not likely to occur that close to shore in the Offshore Area.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), the number of annual training activities that use explosions under Alternative 1 would increase. Under Alternative 1, the total number of explosive training events would increase relative to the No Action Alternative, from the additional use of 18 shock wave action generators (SWAGs) in Crescent Harbor and 18 SWAGs in Hood Canal. The mine neutralization exercises would increase from two 1.5-pound (lb.) (0.68 kg) mine neutralization charges to three 2.5 lb. (1.13 kg) charges in Hood Canal and from two to three 2.5 lb. (1.13 kg) mine neutralization exercises in Crescent Harbor.

As discussed for the No Action Alternative, potential impacts on fish from explosions and impulse sound sources can range from no effect, brief acoustic effects, tactile perception, and physical discomfort, to slight injury to internal organs and the auditory system, to death of the animal (Keevin and Hempen 1997). Occasional behavioral reactions to intermittent explosions and impulse sound sources are unlikely to cause long-term consequences for individual fish or populations. While serious injury or mortality to individual fish would be expected if they were present in the immediate vicinity of explosive ordnance use, despite the increase in activities under Alternative 1, impacts from training activities would be temporary and localized since the activities are infrequent and widely dispersed throughout the Study Area, and the distribution of potentially affected fishes also varies.

Training activities involving impulse acoustic sources in the Inland Waters have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources, the likelihood of these species encountering an explosive activity taking place in the Inland Waters is remote. There is the potential for effects to coho and Chinook designated critical habitat, however, it is unlikely that training activities involving impulse acoustic sources would occur in designated portions of the Inland Waters away from the critical habitat.

Pursuant to the ESA, the use of explosives during training activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

The use of explosives during training activities under Alternative 1 may affect, but is not likely to adversely affect, critical habitat for green sturgeon, chum and Chinook; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

Testing Activities

Offshore Area

Under Alternative 1, fish would be exposed to explosions at or beneath the water surface during testing activities conducted by Naval Sea Systems Command (NAVSEA) and Naval Air Systems Command (NAVAIR) (Tables 2.8-2 and 2.8-3). The only explosives that would be used in offshore areas (beyond 12 nm from shore) due to testing activities would be sonobuoys, torpedoes, and subsurface targets. The number of explosive sonobuoys used in testing activities would increase from 0 in the No Action

Alternative to 142 in Alternative 1. The number of explosive torpedoes would increase from zero in the No Action Alternative to six in Alternative 1.

As discussed for the No Action Alternative, potential impacts on fish from explosions and impulse sound sources can range from no effect, brief acoustic effects, tactile perception, and physical discomfort, to slight injury to internal organs and the auditory system, to death of the animal (Keevin and Hempen 1997). Occasional behavioral reactions to intermittent explosions and impulse sound sources are unlikely to cause long-term consequences for individual fish or populations. It is possible for fish to be injured or killed by explosives; however, long-term consequences from a loss of a few individuals are unlikely to have measureable effects on overall stocks or populations. Therefore, despite the increase in activities under Alternative 1, impacts from at-sea explosion from training activities would be temporary and localized since the activities are infrequent and widely dispersed throughout the Study Area, and the distribution of potentially affected fishes also varies.

Testing activities involving impulse acoustic sources in Offshore Area have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources, the likelihood of these species encountering an explosive activity taking place anywhere within Offshore Area is remote. Effects to chum, Chinook, and bull trout designated critical habitat would not occur as activities do not overlap. There is the potential for effects to green sturgeon designated critical habitat; however, it is unlikely that training activities involving impulse acoustic sources would occur that close to shore in the Offshore Area.

Inland Waters

As described in Tables 2.8-2 and 2.8-3, testing activities under Alternative 1 would not involve explosions.

Pursuant to the ESA, the use of explosives during testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, and Pacific eulachon; and would have no effect on rockfish species.

The use of explosives during testing activities under Alternative 1 may affect, but is not likely to adversely affect, green sturgeon critical habitat; and would have no effect on critical habitat for salmonid species or Pacific eulachon.

3.9.3.1.3.3 Alternative 2

Training Activities

Offshore Area

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), the number of annual training activities that use explosions under Alternative 2 would increase, due to an increase in the GUNEX, even though the SINKEX is removed. Although the number of explosives used in training activities would increase by about 39 percent compared to training activities under the No Action Alternative, these activities would generally occur in the same areas as under the No Action Alternative, and severity of impacts would not be discernable from those described in No Action Alternative – Training Activities.

As discussed for the No Action Alternative, potential impacts on fish from explosions and impulse sound sources can range from no effect, brief acoustic effects, tactile perception, and physical discomfort, to

slight injury to internal organs and the auditory system, to death of the animal (Keevin and Hempen 1997). Occasional behavioral reactions to intermittent explosions and impulse sound sources are unlikely to cause long-term consequences for individual fish or populations. It is possible for fish to be injured or killed by explosives; however, long-term consequences from a loss of a few individuals is unlikely to have measureable effects on overall stocks or populations. Therefore, despite the increase in activities under Alternative 2, impacts from at-sea explosion from training activities would be temporary and localized because the activities are infrequent and widely dispersed throughout the Study Area, and the distribution of potentially affected fishes also varies.

Training activities involving impulse acoustic sources in Offshore Area have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources, the likelihood of these species encountering an explosive activity taking place anywhere within Offshore Area is remote. Effects to chum, Chinook, and bull trout designated critical habitat would not occur as activities do not overlap. There is the potential for effects to green sturgeon designated critical habitat; however, it is unlikely that training activities involving impulse acoustic sources would occur that close to shore in the Offshore Area.

Inland Waters

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), the number of annual training activities that use explosions under Alternative 2 would increase compared to the No Action Alternative. Under Alternative 2, the total number of explosive training events would increase relative to the No Action Alternative, from the additional use of 18 SWAGs in Crescent Harbor and 18 SWAGs in Hood Canal. The mine neutralization exercises would increase from two 1.5 lb. (0.68 kg) mine neutralization charges to three 2.5 lb. (1.13 kg) charges in Hood Canal and from two to three 2.5 lb. (1.13 kg) mine neutralization exercises in Crescent Harbor.

As discussed for the No Action Alternative, potential impacts on fish from explosions and impulse sound sources can range from no effect, brief acoustic effects, tactile perception, and physical discomfort, to slight injury to internal organs and the auditory system, to death of the animal (Keevin and Hempen 1997). Occasional behavioral reactions to intermittent explosions and impulse sound sources are unlikely to cause long-term consequences for individual fish or populations. While serious injury or mortality to individual fish would be expected if they were present in the immediate vicinity of explosive ordnance use, despite the increase in activities under Alternative 2, impacts from at-sea explosion from training activities would be temporary and localized since the activities are infrequent and widely dispersed throughout the Study Area, and the distribution of potentially affected fishes also varies.

Training activities involving impulse acoustic sources in the Inland Waters have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse it is unlikely that training activities involving impulse acoustic sources would occur in designated portions of the Inland Waters away from the critical habitat.

Pursuant to the ESA, the use of explosives during training activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of explosives during training activities under Alternative 2 may affect, but is not likely to adversely affect, green sturgeon, chum, and Chinook critical habitat; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye or Pacific eulachon.

Testing Activities

Offshore Area

Under Alternative 2, fish would be exposed to explosions at or beneath the water surface during testing activities conducted by NAVSEA and NAVAIR (Tables 2.8-2 and 2.8-3). The only explosives that would be used in offshore areas (beyond 12 nm from shore) due to testing activities would be sonobuoys and torpedoes. The number of explosive sonobuoys used in testing activities would increase from 0 in the No Action Alternative to 156 in Alternative 2. The number of explosive torpedoes would increase from zero in the No Action Alternative to eight in Alternative 2.

Proposed testing activities under Alternative 2 that involve explosives and other impulse sources differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernable from those described in the No Action Alternative – Training Activities.

Testing activities involving impulse acoustic sources in Offshore Area have the possibility to affect the ESA-listed species present, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. However, given the infrequent nature of training activities involving impulse acoustic sources and that the likelihood of these species encountering an explosive activity taking place anywhere within Offshore Area is remote. Effects to chum, Chinook, and bull trout designated critical habitat would not occur as activities do not overlap. There is the potential for effects to green sturgeon designated critical habitat; however, it is unlikely that training activities involving impulse acoustic sources would occur that close to shore in the Offshore Area.

Inland Waters

As described in Tables 2.8-2 and 2.8-3, testing activities under Alternative 2 would not involve explosions.

Pursuant to the ESA, the use of explosives during testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, and Pacific eulachon; and would have no effect on rockfish species.

The use of explosives during testing activities under Alternative 2 may affect, but is not likely to adversely affect, green sturgeon critical habitat; and would have no effect on critical habitat for salmonid species or Pacific eulachon.

3.9.3.1.3.4 Summary of Effects to Marine Fish from Acoustic Stressors

Under the No Action Alternative, Alternative 1, or Alternative 2, potential impacts on fish from acoustic and explosive stressors can range from no impact, brief acoustic effects, tactile perception, and physical discomfort; to slight injury to internal organs and the auditory system; to death of the animal (Keevin et al. 1997). Occasional behavioral reactions to intermittent explosives and impulse acoustic sources are unlikely to cause long-term consequences for individual fish or populations. While serious injury or mortality to individual fish would be expected if they were present in the immediate vicinity of explosive ordnance use, impacts from acoustic and explosive stressors would be temporary and localized since the

activities are infrequent and widely dispersed throughout the Study Area, and the distribution of potentially affected fishes also varies.

Pursuant to the ESA, the use of acoustic stressors under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Acoustic stressors under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but is not likely to adversely affect, green sturgeon, chum, and Chinook critical habitat; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye or Pacific eulachon.

3.9.3.2 Energy Stressors

This section analyzes the potential impacts of energy stressors that can occur during training and testing activities within the Study Area, which only includes potential impacts from electromagnetic devices.

3.9.3.2.1 Impacts from Electromagnetic Devices

Electromagnetic devices are used during training and testing activities. A discussion of the type, number, and location of activities using these devices under each alternative is presented in Section 3.0.5.3.2.1 (Electromagnetic).

A comprehensive review of information regarding the sensitivity of marine organisms to electric and magnetic impulses, including fishes comprising the subclass Elasmobranchii (sharks, skates, and rays; hereafter referred to as elasmobranchs), as well as other bony fishes, is presented in Normandeau et al. (2011). The synthesis of available data and information contained in this report suggests that while many fish species (particularly elasmobranchs) are sensitive to electromagnetic fields, further investigation is necessary to understand the physiological response and magnitude of the potential effects. Most examinations of electromagnetic fields on marine fishes have focused on buried undersea cables associated with offshore wind farms in European waters (Boehlert and Gill 2010; Gill 2005; Ohman et al. 2007).

Many fish groups including lamprey, elasmobranchs, eels, salmonids, stargazers, and others, have an acute sensitivity to electrical fields, known as electroreception (Bullock et al. 1983; Helfman et al. 2009b). Electroreceptors are thought to aid in navigation, orientation, and migration of sharks and rays (Kalmijn 2000). In elasmobranchs, behavioral and physiological response to electromagnetic stimulus varies by species and age, and appears to be related to foraging behavior (Rigg et al. 2009). Many elasmobranchs respond physiologically to electric fields of 10 nanovolts (nV) per cm and behaviorally at 5 nV per cm (Collin and Whitehead 2004). Electroreceptive marine fishes with ampullary (pouch) organs can detect considerably higher frequencies of 50 Hz to more than 2 kHz (Helfman et al. 2009b). The distribution of electroreceptors on the head of these fishes, especially around the mouth suggests that these sensory organs may be used in foraging. Additionally, some researchers hypothesize that the electroreceptors aid in social communication (Collin and Whitehead 2004). The ampullae of some fishes are sensitive to low frequencies (< 0.1–25 Hz) of electrical energy (Helfman et al. 2009b), which may be of physical or biological origin, such as muscle contractions. For example, the ampullae of the shovelnose sturgeon (*Scaphirhynchus platorynchus*) were shown to respond to electromagnetic stimuli in a way comparable to the well-studied elasmobranchs, which are sensitive to electric fields as low as 1 microvolt (µV) per cm with a magnetic field of 100 gauss (Bleckmann and Zelick 2009).

While elasmobranchs and other fishes can sense the level of the earth's electromagnetic field, the potential effects on fish resulting from changes in the strength or orientation of the background field are not well understood. When the electromagnetic field is enhanced or altered, sensitive fishes may experience an interruption or disturbance in normal sensory perception. Research on the electrosensitivity of sharks indicates that some species respond to electrical impulses with an apparent avoidance reaction (Helfman et al. 2009b; Kalmijn 2000). This avoidance response has been exploited as a shark deterrent to repel sharks from areas of overlap with human activity (Marcotte and Lowe 2008).

Experiments with electromagnetic pulses can provide indirect evidence of the range of sensitivity of fishes to similar stimuli. Two studies reported that exposure to electromagnetic pulses do not have any effect on fishes (Hartwell et al. 1991; Nemeth and Hocutt 1990). The observed 48-hour mortality of small estuarine fishes (sheepshead minnow [*Cyprinodon variegates*], mummichog [*Fundulus heteroclitus*], Atlantic menhaden [*Brevoorita tyrannus*], striped bass [*Morone saxatilis*], Atlantic silverside [*Menidia menidia*], fourspine stickleback [*Apeltes quadracus*], and rainwater killifish [*Lucania parva*]) exposed to electromagnetic pulses of 100 to 200 kilovolts (kV) per m (10 nanoseconds per pulse) from distances greater than 164 ft. (50 m) was not statistically different than the control group (Hartwell et al. 1991; Nemeth and Hocutt 1990). During a study of Atlantic menhaden, there were no statistical differences in swimming speed and direction (toward or away from the electromagnetic pulse source) between a group of individuals exposed to electromagnetic pulses and the control group (Hartwell et al. 1991; Nemeth and Hocutt 1990).

Both laboratory and field studies confirm that elasmobranchs (and some teleost [bony] fishes) are sensitive to electromagnetic fields, but the long-term impacts are not well-known. Electromagnetic sensitivity in some marine fishes (e.g., salmonids) is already well-developed at early life stages (Ohman et al. 2007), with sensitivities reported as low as 0.6 millivolt per cm in Atlantic salmon (Formicki et al. 2004); however, most of the limited research that has occurred focuses on adults. Some species appear to be attracted to undersea cables while others show avoidance (Ohman et al. 2007). Under controlled laboratory conditions, the scalloped hammerhead (*Sphyrna lewini*) and sandbar shark (*Carcharhinus plumbeus*) exhibited altered swimming and feeding behaviors in response to very weak electric fields (less than 1 µV per cm) (Kajiura and Holland 2002). In a test of sensitivity to fixed magnets, five Pacific sharks were shown to react to magnetic field strengths of 25 to 234 gauss at distances ranging between 0.85 and 1.90 ft. (0.26 and 0.58 m) and avoid the area (Rigg et al. 2009). A field trial in the Florida Keys demonstrated that southern stingray (*Dasyatis americana*) and nurse shark (*Ginglymostoma cirratum*) detected and avoided a fixed magnetic field producing a flux of 950 gauss (O'Connell et al. 2010).

Potential impacts of electromagnetic activity on adult fishes may not be relevant to early life stages (eggs, larvae, juveniles) due to ontogenic (lifestage-based) shifts in habitat utilization (Botsford et al. 2009; Sabates et al. 2007). Some skates and rays produce egg cases that occur on the bottom, while many neonate and adult sharks occur in the water column or near the water surface. Other species may have an opposite life history, with egg and larval stages occurring near the water surface, while adults may be demersal.

Based on current literature, only the fish groups identified above as capable of detecting electromagnetic fields (primarily elasmobranchs, salmonids, tuna, eels, and stargazers) will be carried forward in this analysis and the remaining taxonomic groups (from Table 3.9-2) will not be discussed further.

No electromagnetic energy training or testing activities occur in the Offshore Area or the Western Behm Canal under any alternative. Therefore, these areas will not be further analyzed.

3.9.3.2.1.1 No Action Alternative

Training Activities

Inland Waters

No electromagnetic energy activities occur under training activities in the Inland Waters of the Study Area under the No Action Alternative.

Testing Activities

Inland Waters

No electromagnetic energy activities occur under testing activities in the Inland Waters portion of the Study Area under the No Action Alternative.

Pursuant to the ESA, the use of electromagnetic devices during training activities occurring under the No Action Alternative would have no effect on ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Electromagnetic activities under the No Action Alternative would have no effect on critical habitat for chum, Chinook, coho, steelhead, bull trout, sockeye, Pacific eulachon, or green sturgeon.

3.9.3.2.1.2 Alternative 1

Training Activities

Inland Waters

Table 3.0-15 lists the number and location of electromagnetic energy activities. Under Alternative 1, the Civilian Port Defense exercise that involves purposefully creating an electromagnetic field underwater would occur once every other year within the Inland Waters and have the potential to expose fish to that energy stressor.

Exposure of fishes to electromagnetic stressors is limited to those fish groups identified in Section 3.9.1.2 (Taxonomic Groups) that are able to detect the electromagnetic properties in the water column (Bullock et al. 1983; Helfman et al. 2009b). Species that do occur within the Inland Waters, including all of the ESA-listed species, would have the potential to be exposed to the electromagnetic fields.

Electromagnetic devices are used primarily during mine detection/neutralization activities, and in most cases, the devices simply mimic the electromagnetic signature of a vessel passing through the water. None of the devices include any type of electromagnetic “pulse.” The towed body used for mine sweeping is designed to simulate a ship’s electromagnetic signal in the water, and so would not be experienced by fishes as anything unusual. The static magnetic field generated by the electromagnetic systems is of relatively minute strength, typically 23 gauss at the cable surface and 0.002 gauss at a radius of 656 ft. (199.9 m). The strength of the electromagnetic field decreases quickly away from the cable down to the level of earth’s magnetic field (0.5 gauss) at less than 13 ft. (4.0 m) from the source. In addition, training activities generally occur in the water column, where fishes with high mobility predominate and fish densities are relatively low, compared with nearshore benthic habitat. Because the towed body is continuously moving, most fishes are expected to move away from it or follow behind it, in ways similar to responses to a vessel.

For any electromagnetically sensitive fishes in close proximity to the source, the generation of electromagnetic fields during training activities has the potential to interfere with prey detection and navigation. They may also experience temporary disturbance of normal sensory perception or could experience avoidance reactions (Kalmijn 2000), resulting in alterations of behavior and avoidance of normal foraging areas or migration routes. Mortality from electromagnetic devices is not expected.

Therefore, the electromagnetic devices used would not cause any potential risk to fishes because (1) the range of impact (i.e., greater than earth's magnetic field) is small (i.e., 13 ft. [4.0 m] from the source); (2) the electromagnetic components of these activities are limited to simulating the electromagnetic signature of a vessel as it passes through the water; and (3) the electromagnetic signal is temporally variable and would cover only a small spatial range during each activity in the Study Area. Some fishes could have a detectable response to electromagnetic exposure, but any impacts would be temporary with no anticipated impact on an individual's growth, survival, annual reproductive success, or lifetime reproductive success (i.e., fitness). Fitness refers to changes in an individual's growth, survival, annual reproductive success, or lifetime reproductive success. Electromagnetic exposure of eggs and larvae of sensitive bony fishes would be low relative to their total ichthyoplankton biomass (Able and Fahay 1998) and; therefore, potential impacts on recruitment would not be expected.

The ESA-listed fish species may be capable of detecting electromagnetic energy occurring in the area where electromagnetic training activities are planned. The ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species generally occur in shallow nearshore and coastal waters, and therefore could encounter electromagnetic devices used in training activities in the Inland Waters of the Study Area. If located in the immediate area where electromagnetic devices are being used, ESA-listed species could experience temporary disturbance in normal sensory perception during migratory or foraging movements, or avoidance reactions (Kalmijn 2000), but any disturbance would be inconsequential. The majority of the PCEs required by the salmonid species and Pacific Eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Impacts to designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may occur in the Inland Waters of the Study Area; however, these impacts would be short term. Electromagnetic stressors could impact the critical habitat by temporarily disturbing foraging movements or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Pursuant to the ESA, electromagnetic training activities occurring under Alternative 1 may affect, but are not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Electromagnetic activities under Alternative 1 may affect, but are not likely to adversely affect, critical habitat for Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, Pacific eulachon, or green sturgeon.

Testing Activities

Inland Waters

No electromagnetic energy activities occur under testing activities in the Inland Waters portion of the Study Area under Alternative 1.

No electromagnetic testing activities would occur under Alternative 1; therefore, pursuant to the ESA, there would be no effect on ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

There are no electromagnetic testing activities under Alternative 1; therefore, there would be no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

3.9.3.2.1.3 Alternative 2

Training Activities

Inland Waters

Under Alternative 2, the Civilian Port Defense exercise that involves purposefully creating an electromagnetic field underwater would occur annually within the Puget Sound and have the potential to expose fish to that energy stressor. The impacts would not be discernable from those described above in Alternative 1 – Training Activities.

Pursuant to the ESA, electromagnetic training activities occurring under Alternative 2 may affect, but are not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Electromagnetic activities under Alternative 2 may affect, but are not likely to adversely affect, critical habitat for Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, Pacific eulachon, or green sturgeon.

Testing Activities

Inland Waters

No electromagnetic energy activities occur under testing activities in the Inland Waters portion of the Study Area under Alternative 2.

No electromagnetic testing activities would occur under Alternative 2; therefore, pursuant to the ESA, there would be no effect on ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

There are no electromagnetic testing activities under Alternative 2; therefore, there would be no effect on critical habitat for salmonid species, Pacific eulachon, or green sturgeon.

3.9.3.2.1.4 Summary and Conclusions of Energy Impacts

Under Alternative 1 or Alternative 2 in the Inland Waters, disturbance from activities using electromagnetic energy could be expected to elicit brief behavioral or physiological responses only in those exposed fishes with sensitivities/detection abilities within the corresponding portion of the electromagnetic spectrum that these activities use. For electromagnetic devices, the typical reaction would be for the fish to avoid (move away from) the signal upon detection. The impact of electromagnetic signals are expected to be inconsequential on fishes or fish populations because signals are similar to regular vessel traffic, and the electromagnetic signal would be continuously moving and cover only a small spatial area during use.

Pursuant to the ESA, energy stressors under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but are not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Energy stressors under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but are not likely to adversely affect, critical habitat for Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, Pacific eulachon, or green sturgeon.

3.9.3.3 Physical Disturbance and Strike Stressors

This section evaluates the potential effects of various types of physical disturbance and strike stressors used by Navy during training and testing activities within the Study Area. Table 3.9-4 shows the location and frequency of occurrence within the Study Area of these stressors, by alternative.

Physical disturbance and strike stressors from vessels and in-water devices, military expended materials, and seafloor devices have the potential to affect all marine fish groups found within the Study Area (see Table 3.9-1 and Table 3.9-2), although some fish groups are more susceptible to strike potential than others. The potential responses to physical strikes are varied, but include behavioral changes such as avoidance, altered swimming speed and direction, physiological stress, and physical injury or mortality. Despite their ability to detect approaching vessels using a combination of sensory cues (sight, hearing, lateral line), larger slow-moving fishes (e.g., ocean sunfish, basking sharks, manta rays) cannot avoid all collisions, with some collisions resulting in mortality (Speed et al. 2008).

How a physical strike impacts a fish depends on the relative size of the object potentially striking the fish and the location of the fish in the water column. Before being struck by an object, Atlantic salmon for example, would sense a pressure wave through the water (Hawkins and Johnstone 1978a) and have the ability to swim away from the oncoming object. The movement generated by a large object moving through the water would simply displace small fishes in open water. Some fish might have time to detect the approaching object and swim away; others could be struck before they become aware of the object. An open-ocean fish that is displaced a small distance by movements from an object falling into the water nearby would likely continue on its original path as if nothing had happened. However, a bottom-dwelling fish near a sinking object would likely be disturbed or injured, and may exhibit a general stress response. As in all vertebrates, the function of the stress response in fishes is to rapidly raise the blood sugar level to prepare the fish to flee or fight (Helfman et al. 2009b). This generally adaptive physiological response can become a liability to the fish if the stressor persists and the fish is not able to return to its baseline physiological state. When stressors are chronic, the fish may experience reduced growth, health, or survival (Wedemeyer et al. 1990). If the object hits the fish, direct injury (in addition to stress) or death may result.

Many fishes respond to a sudden physical approach or contact by darting quickly away from the stimulus. Some other species may respond by freezing in place and adopting cryptic coloration. Some other species may respond in an unpredictable manner. Regardless of the response, the individual must stop its current activity and divert its physiological and cognitive attention to responding to the stressor (Helfman et al. 2009b). The energy costs of reacting to a stressor depend on the specific situation, but in all cases the caloric requirements of stress reactions reduce the amount of energy available to the fish for other functions, such as predator avoidance, reproduction, growth, and maintenance (Wedemeyer et al. 1990).

The ability of a fish to return to its previous activity following a physical strike (or near-miss resulting in a stress response) is a function of a variety of factors. Some fish species are more tolerant of stressors than others and become re-acclimated more easily. Experiments with species for use in aquaculture have revealed the immense variability among species in their tolerance to physical stressors. Within a species, the rate at which an individual recovers from a physical strike may be influenced by its age, sex, reproductive state, and general condition. A fish that has reacted to a sudden disturbance by swimming at burst speed would tire after only a few minutes; its blood hormone and sugar levels (cortisol and glucose) may not return to normal for 24 hours or more. During its recovery period, the fish would not be able to attain burst speeds and would be more vulnerable to predators (Wardle 1986). If the individual were not able to regain a steady state following exposure to a physical stressor, it may suffer reduced immune function and even death (Wedemeyer et al. 1990).

Potential impacts of physical disturbance or strike to adults may be different than for other life stages (eggs, larvae, juveniles) because these life stages do not necessarily occur together in the same location (Botsford et al. 2009; Sabates et al. 2007) and because they have different response capabilities. The numbers of eggs and larvae exposed to vessel movements would be low relative to total ichthyoplankton biomass (Able and Fahay 1998); therefore, measurable effects on fish recruitment would not be expected. Also, the early life stages of most marine fishes (excluding sharks and other livebearers) already have extremely high natural mortality rates (10 to 85 percent per day) from predation on these life stages (Helfman et al. 2009b), and, therefore, most eggs and larvae are not expected to survive to the next life stage, as demonstrated by equivalent adult modeling (Horst 1977).

3.9.3.3.1 Impacts from Vessels and In-Water Devices

The majority of the activities under all alternatives involve vessels, and a few of the activities involve the use of in-water devices. For a discussion of the types of activities that use vessels and in-water devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). See Table 3.0-16 for a representative list of Navy vessel types, sizes, and speeds used in the Study Area. Vessels and in-water devices are covered together in this section because they both present similar potential impacts to fishes.

Vessels and in-water devices do not normally collide with adult fish that are not large, slow-moving, or found at the surface since it is expected that they are capable of detection and avoidance. One study on fishes' behavioral responses to vessels showed that most adults exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jørgensen et al. 2004), reducing the potential for vessel strikes. Misund (1997b) found that fishes ahead of a ship that showed avoidance reactions did so at ranges of 160–490 ft. (48.8–149.4 m). When the vessel passed over them, some fishes responded with sudden escape responses that included lateral avoidance or downward compression of the school. Conversely, Rostad et al. (2006) observed that some fishes are attracted to different types of vessels (e.g., research vessels, commercial vessels) of varying sizes, noise levels, and habitat locations. Fish behavior in the vicinity of a vessel is therefore quite variable, depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwarz 1985). Early life stages of most fishes could be displaced by vessels and not struck in the same manner as adults of larger species. However, a vessel's propeller movement or propeller wash could entrain early life stages. The low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses among herring (Chapman and Hawkins 1973a), but avoidance ended within 10 seconds (s) after the vessel departed. Because a towed in-water device is continuously moving, most fishes are expected to move away from it or to follow behind it, in a manner similar to their responses to a vessel. When the device is removed, most fishes would simply move to another area.

There are a few notable exceptions to this assessment of potential vessel strike impacts on marine fish groups. Large slow-moving fish such as ocean sunfish, whale sharks, basking sharks, and manta rays occur near the surface in open-ocean and coastal areas, and are more susceptible to ship strikes, causing blunt trauma, lacerations, fin damage, or mortality. Speed et al. (2008) evaluated this specifically for whale sharks, but these other large slow-moving fishes are also likely to be susceptible because of their similar behavior and location in the water column. Increases in the numbers and sizes of shipping vessels in the modern cargo fleets make it difficult to gather mortality data because personnel on large ships are often unaware of whale shark collisions (Stevens 2007); therefore, the occurrence of whale shark strikes is likely much higher than has been documented by the few studies that have been conducted. The results of a whale shark study outside of the Study Area in the Gulf of Tadjoura, Djibouti, revealed that of the 23 whale sharks observed during a 5-day period, 65 percent had scarring from boat and propeller strikes (Rowat et al. 2007a). Based on the typical physiological responses described in Section 3.9.3.3 (Physical Disturbance and Strike Stressors), vessel movements are not expected to compromise the general health or condition of individual fishes, except for whale sharks, basking sharks, manta rays, and ocean sunfish.

Exposure of fishes to vessel strike stressors is limited to those fish groups identified in Section 3.9.1.2 (Taxonomic Groups) that are large, slow-moving, and may occur near the surface, such as ocean sunfish, whale sharks, and basking sharks. These species are distributed widely in offshore and nearshore portions of the Study Area. Any isolated cases of a Navy vessel striking an individual could injure that individual, impacting the fitness of an individual fish, but not to the extent that the viability of populations would be impacted. Vessel strikes would not pose a risk to most of the other marine fish groups because many fish can detect and avoid vessel movements, making strikes rare and allowing the fish to return to their normal behavior after the ship or device passes. As a vessel approaches a fish, they could have a detectable behavioral or physiological response (e.g., swimming away and increased heart rate) as the passing vessel displaces them. However, such reactions are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of these marine fish groups at the population level.

Operational features of in-water devices and their use substantially limit the exposure of fish to potential strikes. First, in-water devices would not pose any strike risk to benthic fishes because the towed equipment is designed to stay off the bottom. Secondly, prior to deploying a towed in-water device, there is a standard operating procedure to search the intended path of the device for any floating debris (i.e., driftwood), marine life, or other potential obstructions, since they have the potential to cause damage to the device.

The likelihood of strikes by towed mine warfare devices on adult fish, which could result in injury or mortality, would be extremely low because these life stages are highly mobile. The use of in-water devices may result in short-term and local displacement of fishes in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness or species recruitment, and are not expected to result in population-level impacts. Ichthyoplankton (fish eggs and larvae) in the water column could be displaced, injured, or killed by towed mine warfare devices. The numbers of eggs and larvae exposed to vessels or in-water devices would be extremely low relative to total ichthyoplankton biomass (Able and Fahay 1998); therefore, measurable changes on fish recruitment would not occur.

3.9.3.3.1.1 No Action Alternative

Training Activities

Offshore Area

The number of annual Navy training activities including vessels and in-water devices under the No Action Alternative is shown in Table 3.9-4. As indicated in Section 3.0.5.3.3.1 (Vessels) and Section 3.0.5.3.3.2 (In-Water Devices), training activities involving in-water devices can occur anywhere in the Study Area. Navy vessel activity primarily occurs within the U.S. Exclusive Economic Zone and certain portions of the Study Area, such as areas near ports or naval installations and training ranges. These activities do not differ seasonally and could be widely dispersed throughout the Study Area. Species that do not occur near the surface within the Study Area would not be exposed to vessel strike potential. Species that occur near the surface within the Study Area—including the ESA-listed salmonid species and Pacific eulachon—could potentially be exposed to vessel strikes.

The risk of a strike from vessels and in-water devices used in training activities would be extremely low because (1) most fish can detect and avoid vessel and in-water device movements, and (2) the types of fish that are likely to be exposed to vessel and in-water device strike are limited and occur in low concentrations where vessels and in-water devices are used. Potential impacts from exposure to vessels and in-water devices are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment and are not expected to result in population-level impacts. Since impacts from strikes would be rare and for the reasons stated above, impacts on fish or fish populations under the No Action Alternative would be negligible.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal portions of the Offshore Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a) and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and therefore would not be in areas where they could collide with vessels and in-water devices. Therefore, while vessels and in-water devices could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, maturing sites, and migration corridors), and are outside the Study Area. Therefore, vessel device use in the Offshore Area would have no effect on the salmonid species and Pacific eulachon critical habitats. While there would be an overlap of the vessel use with green sturgeon critical habitat, it is unlikely that a vessel would impact the bottom substrate and critical habitat.

Inland Waters

As indicated in Section 3.0.5.3.3.1 (Vessels) and Section 3.0.5.3.3.2 (In-Water Devices), training activities involving vessels and in-water devices can occur anywhere in the Study Area. Navy vessel activity primarily occurs within the U.S. Exclusive Economic Zone and certain portions of the Study Area, such as areas near ports or naval installations and training ranges are used more heavily by vessels than other portions of the Study Area. There are no activities involving in-water devices proposed under training activities in the No Action Alternative in the Inland Waters portion of the Study Area. Species that occur near the surface within the Study Area—including the ESA-listed salmonid species and Pacific eulachon—would have the potential to be exposed to vessel device strikes.

The risk of a strike from vessels used in training activities under the No Action Alternative would be extremely low because (1) most fish can detect and avoid vessel device movements, and (2) the types of

fish that are likely to be exposed to vessel strike are limited and occur in low concentrations where vessels are used. Potential impacts of exposure to vessels and in-water devices are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment and are not expected to result in population-level impacts. Since impacts from strikes would be rare, impacts on fish or fish populations would be negligible.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal areas of the Study Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore avoid collision with vessels. Therefore, while vessels could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Inland Waters portion of the Study Area. Impacts to designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may occur in the Inland Waters of the Study Area; however, these impacts would be temporary and short term. Vessel use could impact the critical habitat by temporarily disturbing the water column or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species and Pacific eulachon; and would have no effect on ESA-listed green sturgeon and rockfish species.

The use of vessels and in-water devices during training activities under the No Action Alternative may affect, but is not likely to adversely affect, nearshore designated critical habitat for green sturgeon, Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

Under the No Action Alternative, 37 activities that include vessel movement and 40 activities that include in-water devices would occur during testing activities in the Offshore Area. Surf zone activities, including the use of crawlers, would occur in the Offshore Area of the Study Area at Pacific Beach in the Quinault Range Site, which extends north to south 5 nm along the eastern boundary of Warning Area 237A, approximately 3 nm to shore along the mean low water line, and encompasses 1 mi. (1.6 km) of shoreline at Pacific Beach, Washington. Proposed testing activities under the No Action Alternative that involve vessels and in-water devices differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernable from those described under the No Action Alternative – Training Activities.

Inland Waters

Under the No Action Alternative, 337 activities that include vessel movement and 379 activities that include in-water devices would occur during testing activities, and no activities using crawlers would occur in the Inland Waters.

Proposed testing activities under the No Action Alternative that involve vessels and in-water devices differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernable from those described under the No Action Alternative – Training Activities.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal areas of the Study Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore avoid collision with vessels. Therefore, while vessels could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Inland Waters portion of the Study Area. Impacts to designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may occur in the Inland Waters of the Study Area; however, these impacts would be temporary and short term. Vessel use could impact the critical habitat by temporarily disturbing the water column or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Western Behm Canal, Alaska

Under the No Action Alternative, 28 annual testing activities that include vessel movement would occur in the Western Behm Canal. There are no in-water devices proposed for use in the Western Behm Canal.

The risk of a strike from vessels used in training activities under the No Action Alternative would be extremely low because (1) most fish can detect and avoid vessel device movements, and (2) the types of fish that are likely to be exposed to vessel strike are limited and occur in low concentrations where vessels are used. Potential impacts of exposure to vessels are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment and are not expected to result in population-level impacts. Since impacts from strikes would be rare, impacts on fish or fish populations would be negligible.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, impacts from activities including vessel to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, and Pacific eulachon; and would have no effect on green sturgeon and rockfish species.

The use of vessels and in-water devices under the No Action Alternative during testing activities may affect, but is not likely to adversely affect, nearshore designated critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye species.

3.9.3.3.1.2 Alternative 1

Training Activities

Offshore Area

The vessels and in-water devices used during training activities under Alternative 1 would increase from 1,425 activities under the No Action Alternative to 1,572 activities. These activities would be widely dispersed throughout the Offshore Area of the Study Area (Table 3.9-4).

Proposed training activities under Alternative 1 that include vessels and in-water devices differ in number from training activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Training Activities.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal portions of the Offshore Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore not be in areas where they could collide with vessels and in-water devices. Therefore, while vessels and in-water devices could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, maturing sites, and migration corridors), and are outside the Study Area. Therefore, vessel device use in the Offshore Area would have no effect on the salmonid species and Pacific eulachon critical habitats. While there would be an overlap of the vessel use with green sturgeon critical habitat, it is unlikely that a vessel would impact the bottom substrate and critical habitat.

Inland Waters

Training activities including vessels in the Inland Waters are proposed to increase from 4 annual activities under the No Action Alternative to 28 under Alternative 1, while activities including in-water devices would increase from 0 to 1 every other year (Table 3.9-4). The increases are from an increase in small boat activity, the addition of precision anchoring exercises in which ships are at slow speeds or stopped, and the new civilian port defense exercise, conducted once every two years in the Puget Sound.

Proposed training activities under Alternative 1 that include vessels and in-water devices differ in number from training activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Training Activities.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal areas of the Study Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore avoid collision with vessels. Therefore, while vessels could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Inland Waters portion of the Study Area. Impacts to

designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may occur in the Inland Waters of the Study Area; however, these impacts would be temporary and short term. Vessel use could impact the critical habitat by temporarily disturbing the water column or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species and Pacific eulachon; and would have no effect on ESA-listed green sturgeon and rockfish species.

The use of vessels and in-water devices under Alternative 1 during training activities may affect, but is not likely to adversely affect, nearshore designated critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

Testing activities including vessels in the Offshore Area are proposed to increase from 37 annual activities under the No Action Alternative to 138 under Alternative 1, while activities including in-water devices would increase from 40 to 154 (Table 3.9-4).

Despite the increase in training activities over the No Action Alternative, the impact of vessels and in-water devices on fish would be inconsequential because (1) most fish can detect and avoid vessel device movements, and (2) the types of fish that are likely to be exposed to vessel strike are limited and occur in low concentrations where vessels are used. Potential impacts of exposure to vessels are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment and are not expected to result in population-level impacts. Since impacts from strikes would be rare, impacts on fish or fish populations would be negligible.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal portions of the Offshore Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a) and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore not be in areas where they could collide with vessels and in-water devices. Therefore, while vessels and in-water devices could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, maturing sites, and migration corridors), and are outside the Study Area. Therefore, vessel device use in the Offshore Area would have no effect on the salmonid species and Pacific eulachon critical habitats. While there would be an overlap of the vessel use with green sturgeon critical habitat, it is unlikely that a vessel would impact the bottom substrate and critical habitat.

Inland Waters

Testing activities including vessels in the Inland Waters are proposed to increase from 337 annual activities under the No Action Alternative to 582 under Alternative 1, while activities including in-water devices would increase from 379 to 648 (Table 3.9-4).

Proposed testing activities under Alternative 1 that include vessels and in-water devices differ in number from testing activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Testing Activities.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal areas of the Study Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore avoid collision with vessels. Therefore, while vessels could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Inland Waters portion of the Study Area. Impacts to designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may occur in the Inland Waters of the Study Area; however, these impacts would be temporary and short term. Vessel use could impact the critical habitat by temporarily disturbing the water column or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Western Behm Canal, Alaska

Testing activities including vessels in the Western Behm Canal are proposed to increase from 28 annual activities under the No Action Alternative to 60 under Alternative 1, while there are no activities including in-water devices proposed for Alternative 1 (Table 3.9-4).

Proposed testing activities under Alternative 1 that include vessels differ in number from testing activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Testing Activities.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, impacts from activities including vessel to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species and Pacific eulachon; and would have no effect on ESA-listed green sturgeon and rockfish species.

The use of vessels and in-water devices under Alternative 1 during testing activities may affect, but is not likely to adversely affect, nearshore designated critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

3.9.3.3.1.3 Alternative 2

Training Activities

Offshore Area

Training activities including vessels in the Offshore Area are proposed to increase from 996 annual activities under the No Action Alternative to 1,096 under Alternative 2, while activities including in-water devices would increase from 429 to 484 (Table 3.9-4).

Proposed training activities under Alternative 2 that include vessels and in-water devices differ in number from training activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Training Activities.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal portions of the Offshore Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a) and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore not be in areas where they could collide with vessels and in-water devices. Therefore, while vessels and in-water devices could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, maturing sites, and migration corridors), and are outside the Study Area. Therefore, vessel device use in the Offshore Area would have no effect on the salmonid species and Pacific eulachon critical habitats. While there would be an overlap of the vessel use with green sturgeon critical habitat, it is unlikely that a vessel would impact the bottom substrate and critical habitat.

Inland Waters

Training activities including vessels in the Inland Waters are proposed to increase from 4 annual activities under the No Action Alternative to 28 under Alternative 2, while activities including in-water devices would increase from 0 to 1 every year (Table 3.9-4). The increases are from an increase in small boat activity, the addition of precision anchoring exercises in which ships are at slow speeds or stopped, and the new civilian port defense exercise, conducted once per year in the Puget Sound.

Proposed training activities under Alternative 2 that include vessels and in-water devices differ in number from training activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Training Activities.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal areas of the Study Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore avoid collision with vessels. Therefore, while vessels could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Inland Waters portion of the Study Area. Impacts to designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may

occur in the Inland Waters of the Study Area; however, these impacts would be temporary and short term. Vessel use could impact the critical habitat by temporarily disturbing the water column or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species and Pacific eulachon; and would have no effect on ESA-listed green sturgeon and rockfish species.

The use of vessels and in-water devices under Alternative 2 during training activities may affect, but is not likely to adversely affect, nearshore designated critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

Testing activities including vessels in the Offshore Area are proposed to increase from 37 annual activities under the No Action Alternative to 162 under Alternative 2, while activities including in-water devices would increase from 40 to 183 (Table 3.9-4).

Despite the increase in training activities over the No Action Alternative, the impact of vessels and in-water devices on fish would be inconsequential because (1) most fish can detect and avoid vessel device movements, and (2) the types of fish that are likely to be exposed to vessel strike are limited and occur in low concentrations where vessels are used. Potential impacts of exposure to vessels are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment and are not expected to result in population-level impacts. Since impacts from strikes would be rare, impacts on fish or fish populations would be negligible.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal portions of the Offshore Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a) and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore not be in areas where they could collide with vessels and in-water devices. Therefore, while vessels and in-water devices could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, maturing sites, and migration corridors), and are outside the Study Area. Therefore, vessel device use in the Offshore Area would have no effect on the salmonid species and Pacific eulachon critical habitats. While there would be an overlap of the vessel use with green sturgeon critical habitat, it is unlikely that a vessel would impact the bottom substrate and critical habitat.

Inland Waters

Testing activities including vessels in the Inland Waters are proposed to increase from 337 annual activities under the No Action Alternative to 640 under Alternative 2, while activities including in-water devices would increase from 379 to 716 (Table 3.9-4).

Despite the increase in training activities over the No Action Alternative, the impact of vessels and in-water devices on fish would be inconsequential because (1) most fish can detect and avoid vessel device movements, and (2) the types of fish that are likely to be exposed to vessel strike are limited and occur in low concentrations where vessels are used. Potential impacts of exposure to vessels are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment and are not expected to result in population-level impacts. Since impacts from strikes would be rare, impacts on fish or fish populations would be negligible.

Based on the primarily nearshore distribution of all ESA-listed species and overlap of vessel use, potential strike risk would be greatest in the coastal areas of the Study Area. The salmonid ESA-listed species and Pacific eulachons can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. The rockfish species and green sturgeon are bottom-dwelling and would therefore avoid collision with vessels. Therefore, while vessels could overlap with the salmonid species and Pacific eulachon, the likelihood of a strike would be extremely low, with discountable effects. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Inland Waters portion of the Study Area. Impacts to designated chum and Chinook nearshore critical habitat, including the nearshore marine PCEs, may occur in the Inland Waters of the Study Area; however, these impacts would be temporary and short term. Vessel use could impact the critical habitat by temporarily disturbing the water column or avoidance reactions of the ESA-listed species or their prey. Impacts to designated steelhead, coho, sockeye, green sturgeon, and Pacific eulachon critical habitat would not occur as activities do not overlap.

Western Behm Canal, Alaska

Testing activities including vessels in the Western Behm Canal are proposed to increase from 28 annual activities under the No Action Alternative to 83 under Alternative 2, while there are no activities including in-water devices proposed for Alternative 2 (Table 3.9-4).

Proposed testing activities under Alternative 2 that include vessels differ in number from testing activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernable from those described in No Action Alternative – Testing Activities.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, impacts from activities including vessel to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species and Pacific eulachon; and would have no effect on green sturgeon and rockfish species.

The use of vessels and in-water devices under Alternative 2 during testing activities may affect, but is not likely to adversely affect, nearshore designated critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

3.9.3.3.2 Impacts from Military Expended Materials

Navy training and testing activities in the Study Area include firing a variety of weapons and employing a variety of explosive and non-explosive rounds including bombs, and small-, medium-, and large-caliber projectiles, or even sinking entire ship hulks during a sinking exercise (SINKEX). During these training and testing activities, various items may be introduced and expended into the marine environment and are referred to as military expended materials.

This section analyzes the strike potential to marine fish of the following categories of military expended materials: (1) non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expended materials other than ordnance, such as sonobuoys, vessel hulks, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.3 (Military Expended Material).

While disturbance or strike from any of these objects as they sink through the water column is possible, it is not very likely for most expended materials because the objects generally sink through the water slowly and can be avoided by most fishes. Therefore, with the exception of SINKEX, the discussion of military expended materials strikes focuses on strikes at the surface or in the upper water column from fragments (of high-explosives) and projectiles because those items have a greater potential for a fish strike as they hit the water, before slowing down as they move through the water column.

Vessel Hulk. During a SINKEX, aircraft, ship, and submarine crews deliver ordnance on a seaborne target, usually a clean deactivated ship (see Section 3.1, Sediments and Water Quality), which is deliberately sunk using multiple weapon systems. Sinking exercises occur in specific open ocean areas, outside of the coastal range complexes, in waters exceeding 6,000 ft. (1,829 m) in depth. Direct ordnance strikes from the various weapons used in these exercises are a source of potential impact. However, these impacts are discussed for each of those weapons categories in this section and are not repeated here. Therefore, the analysis of SINKEX as a strike potential for benthic fishes is discussed in terms of the ship hulk landing on the seafloor.

Small-, Medium-, and Large-Caliber Projectiles. Various types of projectiles could cause a temporary (seconds), localized impact when they strike the surface of the water. Current Navy training and testing in the Study Area, such as GUNEX, include firing a variety of weapons and using a variety of non-explosive training and testing rounds, including 5 in. (12.7 cm) naval gun shells, torpedoes, and small-, medium-, and large-caliber projectiles. See Table 3.0-20 for information regarding the number and location of activities involving small- and medium-caliber non-explosive practice munitions. The larger-caliber projectiles are primarily used in the open ocean beyond 20 nm. Direct ordnance strikes from firing weapons are potential stressors to fishes. There is a remote possibility that an individual fish at or near the surface may be struck directly if it is at the point of impact at the time of non-explosive ordnance delivery. Expended rounds may strike the water surface with sufficient force to cause injury or mortality. However, limited fish species swim right at, or near, the surface of the water (e.g., with the exception of pelagic sharks, herring, salmonids, flying fishes, jacks, tuna, mackerels, billfishes, ocean sunfishes, and other similar species).

Various projectiles would fall on soft or hard bottom habitats where they could either become buried immediately in the sediments or sit on the bottom for an extended time period. Except for the 5 in. (12.7 cm) and the 30 mm (1.18 in.) rounds, which are fired from a helicopter, all projectiles would be aimed at surface targets. These targets would absorb most of the projectiles' energy before they strike

the surface of the water and sink. This factor would limit the possibility of high-velocity impacts with fish from the rounds entering the water. Furthermore, fish are likely to quickly and easily leave an area temporarily when vessels or helicopters approach. It is reasonable to assume, therefore, that fish would leave an area prior to, or just after the onset of, projectile firing and would return once tests are completed.

Most ordnance would sink through the water column and come to rest on the seafloor, stirring up sediment and possibly inducing a startle response, displacing, or injuring nearby fishes in extremely rare cases. Particular impacts on a given fish species would depend on the size and speed of the ordnance, the water depth, the number of rounds delivered, the frequency of training and testing, and the sensitivity of the fish.

Bombs, Missiles, and Rockets. Direct ordnance strikes from bombs, missiles, and rockets are potential stressors to fishes. Some individual fish at or near the surface may be struck directly if they are at the point of impact at the time of non-explosive ordnance delivery. However, most missiles hit their target or are disabled before hitting the water. Thus, most of these missiles and aerial targets hit the water as fragments, which quickly dissipates their kinetic energy within a short distance of the surface. A limited number of fishes swim at or near the surface of the water, as described for small-, medium-, and large-caliber projectiles.

As discussed in Appendix I (Statistical Strike Probability), statistical modeling conducted for the Study Area indicates that the probability of military expended materials striking marine mammals is extremely low. Statistical modeling could not be conducted to estimate the probability of military expended material strikes on fish because fish density data are not available at the scale of an OPAREA or testing range.

In lieu of strike probability modeling, the number, size, and area of potential impact (or “footprints”) of each type of military expended material is presented in Tables 3.3-4 through 3.3-7. The application of this type of footprint analysis to fish follows the assumption that a fish occupying the impact area could be susceptible to potential impacts, either at the water surface (e.g., pelagic sharks, salmonids, flying fishes, jacks, tuna, mackerels, billfishes, and ocean sunfishes [see Table 3.9-2]) or as military expended material falls through the water column and settles to the bottom (e.g., flounders, skates, and other benthic fishes listed in Table 3.9-2). Furthermore, most of the projectiles fired during training and testing activities are fired at targets, and most projectiles hit those targets, so only a very small portion of those would hit the water with their maximum velocity and force. Of that small portion, a small number of fish at or near the surface (pelagic fishes) or near the bottom (benthic fishes) may be directly impacted if they are in the target area and near the expended item that hits the water surface (or bottom), but population-level effects would not occur.

Propelled fragments are produced by an exploding bomb or missile. Close to the explosion, fishes could potentially sustain injury or death from propelled fragments (Stuhmiller et al. 1990). However, studies of underwater bomb blasts have shown that fragments are larger than those produced during air blasts and decelerate much more rapidly (O'Keefe and Young 1984; Swisdak Jr. and Montaro 1992), reducing the risk to marine organisms.

Fish disturbance or strike could result from bomb fragments (after explosion) falling through the water column in very small areas compared to the vast expanse of the testing ranges, OPAREAs, range complexes, or the Study Area. The expected reaction of fishes exposed to this stressor would be to

immediately leave the area where explosions are occurring, thereby reducing the probability of a fish strike after the initial expended materials hit the water surface. When a disturbance of this type concludes, the area would be repopulated and the fish stock would rebound with inconsequential impacts on the resource (Lundquist et al. 2010).

No training or testing activities that would result in military expended materials are proposed in the Western Behm Canal portion of the Study Area under any Alternative. Therefore, there would be no impacts to fish in the Western Behm Canal portion of the Study Area from military expended materials under any alternative.

3.9.3.3.2.1 No Action Alternative

Training Activities

Offshore Area

Table 3.9-4 lists the number and location of military expended materials, most of which are small- and medium caliber projectiles. As indicated in Section 3.0.5.3.3.3 (Military Expended Material), under the No Action Alternative, military expended material use can occur throughout the Study Area.

Marine fish groups identified in Section 3.9.2.5 (Taxonomic Group Descriptions and Distribution) that are particularly susceptible to military expended material strikes are those occurring at the surface within the offshore and continental shelf portions of the range complexes (where the strike would occur). Those groups include pelagic sharks, salmonids, flying fishes, jacks, tuna, mackerels, billfishes, ocean sunfishes, and other similar species (see Table 3.9-2). Additionally, certain deep-sea fishes would be exposed to strike risk as a ship hulk, expended during a SINKEX, settles to the seafloor. These groups include hagfishes, dragonfishes, lanternfishes, anglerfishes, and oarfishes.

Projectiles, bombs, missiles, rockets, and associated fragments have the potential to directly strike fish as they hit the water surface and below the surface to the point where the projectile loses its forward momentum. Fish at and just below the surface would be most susceptible to injury from strikes because velocity of these materials would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, most water column fishes would have ample time to detect and avoid approaching munitions or fragments as they fall through the water column. The probability of strike based on the “footprint” analysis included in Tables 3.3-4 through 3.3-7 indicates that even for an extreme case of expending all small-caliber projectiles within a single gunnery box, the probability of any of these items striking a fish (even as large as bluefin tuna or whale sharks) is extremely low. Therefore, since most fishes are smaller than bluefin tuna or whale sharks and most military expended materials are less abundant than small-caliber projectiles, the risk of strike by these items is exceedingly low for fish overall. A possibility exists that a small number of fish at or near the surface may be directly impacted if they are in the target area and near the point of physical impact at the time of military expended material strike, but population-level impacts would not occur.

Sinking exercises occur in open-ocean areas, outside of the coastal range complexes. During each SINKEX, approximately 725 objects would be expended, including large bombs, missiles, large projectiles, torpedoes, and one target vessel. Therefore, during each SINKEX, approximately 272 objects per square mile (105 objects per square kilometer) would sink to the ocean floor. While serious injury or mortality to individual fish would be expected if they were present within range of high explosive activities (analyzed in Section 3.9.3.1, Acoustic Stressors), SINKEX under the No Action Alternative would not result in impacts on pelagic fish populations at the surface based on the low number of fish in the immediate area and the placement of these activities in deep, ocean areas where fish abundance is low

or widely dispersed. Disturbances to benthic fishes from SINKEX would be highly localized. Any deep sea fishes located on the bottom where a ship hulk would settle could experience displacement, injury, or death. However, population level impacts on the deep sea fish community would not occur because of the limited spatial extent of the impact and the wide dispersal of fishes in deep ocean areas.

The impact of military expended material strikes would be inconsequential due to the (1) limited number of species found directly at the surface where military expended material strikes could occur; (2), the rare chance that a fish might be directly struck at the surface by military expended materials, and; (3) the ability of most fish to detect and avoid an object falling through the water below the surface. The potential impacts of military expended material strikes would be short-term and localized disturbances of the water column (and seafloor areas within SINKEX locations).

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, maturation sites, and migration corridors) and are outside the Offshore Area. Therefore, military expended materials use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of military expended materials in the Offshore Area, however, but impacts would be short-term and localized disturbances of the water column and displacement of sediments where objects would sink.

Inland Waters

Table 3.9-4 lists the number and location of military expended materials, most of which are mine shapes and underwater detonations. As indicated in Section 3.0.5.3.3.3 (Military Expended Material), under the No Action Alternative, military expended material use can occur throughout the Study Area.

The impact of military expended material strikes would be inconsequential due to the (1) limited number of species found directly at the surface where military expended material strikes could occur; (2) the rare chance that a fish might be directly struck at the surface by military expended materials, and; (3) the ability of most fish to detect and avoid an object falling through the water below the surface. The potential impacts of military expended material strikes would be short-term and localized disturbances of the water column (and seafloor areas within SINKEX locations).

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, military expended materials use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Military expended materials use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters including disturbances of the water column and displacement of sediments where objects would sink. However, any impacts are expected to be localized and temporary.

Pursuant to the ESA, military expended material strikes during training activities under the No Action Alternative may affect, but are not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Military expended material strikes during training activities under the No Action Alternative may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

Under the No Action Alternative, the Navy proposes testing activities in the Offshore Area that would result in the expenditure of approximately 600 items, most of which are sonobuoys and smaller miscellaneous items related to torpedo testing (Table 3.9-4).

The potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for training activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, military expended materials use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of military expended materials in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where objects would sink.

Inland Waters

Table 3.9-4 lists the number of military expended materials used in the Inland Waters under the No Action Alternative, most of which are fiber optic cables, guidance wires, and miscellaneous items related to NAVSEA torpedo testing.

The potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for training activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, military expended materials use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Military expended materials use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where objects would sink.

Pursuant to the ESA, military expended material strikes during testing activities under the No Action Alternative may affect, but are not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Military expended material strikes during testing activities under the No Action Alternative may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

3.9.3.3.2.2 Alternative 1

Training Activities

Offshore Area

Table 3.9-4 lists the number and location of military expended materials as indicated in Section 3.0.5.3.3.3 (Military Expended Material), under Alternative 1, military expended material use can occur throughout the Study Area. The overall number of military expended materials increases from 189,668 under the No Action Alternative to 196,888 under Alternative 1 mainly due to an increase in small caliber and chaff utilization.

The potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for training activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, military expended materials use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of military expended materials in the Offshore Area. However, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where objects would sink.

Inland Waters

Table 3.9-4 lists the number and location of military expended materials, most of which are mine shapes and underwater detonations. As indicated in Section 3.0.5.3.3.3 (Military Expended Material), under Alternative 1, military expended material use can occur throughout the Study Area. The military expended materials would increase from 8 under the No Action Alternative to 85 for Alternative 1 (Table 3.9-4).

Compared to the No Action Alternative, the overall increase in military expended materials used under Alternative 1 would result in slightly increased exposure of fish to military expended materials. The potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface (and seafloor areas within SINKEX locations) and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for training activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature

of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, military expended materials use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Military expended materials use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where objects would sink.

Pursuant to the ESA, military expended material strikes during training activities under Alternative 1 may affect, but are not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Military expended material strikes during training activities under Alternative 1 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on coho, steelhead, bull trout, and sockeye, and Pacific eulachon critical habitat.

Testing Activities

Offshore Area

As indicated in Table 3.9-4, military expended materials would increase from approximately 621 under the No Action Alternative to 2,511 under Alternative 1.. Compared to the No Action Alternative, the overall increase in military expended materials used under Alternative 1 is due primarily to a large increase in sonobuoys and their decelerator/parachutes from NAVAIR sonobuoy testing. These changes would result in increased exposure of fish to military expended materials; however, the probability of strike based on the “footprint” analysis included in Table 3.3-4 indicates that the probability of any of these items striking a fish (even as large as bluefin tuna or whale sharks) is extremely low. Despite the increase in military expended materials under Alternative 1, the potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for testing activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, military expended materials use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of military expended materials in the Offshore Area. However, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where objects would sink.

Inland Waters

Table 3.9-4 lists the number of military expended materials used in the Inland Waters under Alternative 1, most of which are fiber optic cables, guidance wires, and miscellaneous items related to NAVSEA torpedo testing. The military expended materials would increase from 446 under the No Action Alternative to 517 for Alternative 1.

Compared to the No Action Alternative, the overall increase in military expended materials used under Alternative 1 is due to an increase in the same type and location of activities. These changes would result in increased exposure of fish to military expended materials; however, the probability of strike based on the "footprint" analysis included in Table 3.3-6 indicates that the probability of any of these items striking a fish is extremely low. The potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for training activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, military expended materials use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Military expended materials use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where objects would sink.

Pursuant to the ESA, military expended material strikes during testing activities under Alternative 1 may affect, but are not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Military expended material strikes during testing activities under Alternative 1 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

3.9.3.3.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the Navy proposes the same type and tempo of activity resulting in the same quantity of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on fish would be the same as for Alternative 1.

Inland Waters

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative would also be identical as described in Section 3.9.3.3.2.2 (Alternative 1).

Pursuant to the ESA, military expended material strikes during training activities under Alternative 2 may affect, but are not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Military expended material strikes during training activities under Alternative 2 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

As indicated in Table 3.9-4, military expended materials from testing activities would increase from approximately 621 under the No Action Alternative to 2,764 under Alternative 2. The overall increase in military expended materials used under Alternative 2 is due primarily to a large increase in sonobuoys and their decelerator/parachutes from NAVAIR sonobuoy testing. This equates to an approximately 10 percent increase in the numbers of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 testing activities on fish would be similar to Alternative 1.

Inland Waters

Table 3.9-4 lists the number of military expended materials used in the Inland Waters under Alternative 2, most of which are fiber optic cables, guidance wires, and miscellaneous items related to NAVSEA torpedo testing. The military expended materials would increase from 446 under the No Action Alternative to 568 for Alternative 2 (Table 3.9-4).

Compared to the No Action Alternative, the overall increase in military expended materials used under Alternative 2 is due to an increase in the same type and location of activities. These changes would result in increased exposure of fish to military expended materials; however, the probability of strike based on the "footprint" analysis included in Table 3.3-6 indicates that the probability of any of these items striking a fish is extremely low. The potential impacts of military expended material strikes would be short-term and localized disturbances of the water surface (and seafloor areas within SINKEX locations) and would be inconsequential for the same reasons stated under the analysis under the No Action Alternative for testing activities.

While military expended materials use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from military expended materials in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, military expended materials use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Military expended materials use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where objects would sink.

Pursuant to the ESA, military expended material strikes during testing activities under Alternative 2 may affect, but are not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species..

Military expended material strikes during testing activities under Alternative 2 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, and Pacific eulachon.

3.9.3.3.3 Impacts from Seafloor Devices

For a discussion of the types of activities that use seafloor devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.4 (Seafloor Devices). Seafloor devices include items that are placed on, dropped on, or moved along the seafloor such as mine shapes, anchor blocks, anchors, bottom-placed instruments, bottom-crawling unmanned undersea vehicles, and

bottom-placed targets that are not expended. As discussed in the military expended materials strike section, objects falling through the water column would slow in velocity as they sink toward the bottom and could be avoided by most fish.

Seafloor devices with a strike potential for fish include those items temporarily deployed on the seafloor. The potential strike impacts of unmanned underwater vehicles, including bottom crawling types, are also included here. Some fishes are attracted to virtually any tethered object in the water column for food or refuge (Dempster and Taquet 2004) and could be attracted to an inert mine assembly. However, while a fish might be attracted to the object, their sensory abilities allow them to avoid colliding with fixed tethered objects in the water column (Bleckmann and Zelick 2009), so the likelihood of a fish striking one of these objects is implausible. Therefore, strike hazards associated with collision into other seafloor devices such as deployed mine shapes or anchored devices are highly unlikely to pose any strike hazard to fishes and are not discussed further. A possibility exists that a small number of fish at or near the surface or resting on the bottom may be directly impacted if they are in the target area and near the point of physical impact at the time of seafloor device strike. However, the likelihood of one of these objects striking a fish is implausible, and in the rare event that a strike occurred, population-level impacts would not occur.

Table 3.9-4 lists the number and location of activities that use seafloor devices. As indicated in Table 3.9-4, there are no training activities proposed in the Offshore Area or the Western Behm Canal under any Alternative; therefore, those areas will not be analyzed for impacts under training activities.

3.9.3.3.3.1 No Action Alternative

Training Activities

Inland Waters

As indicated in Table 3.9-4, there are two proposed training activities in the Inland Waters in which seafloor devices are used. Both of these activities are Explosive Ordnance Disposal (EOD) mine neutralization exercises where mine shapes may be anchored or moored to the ocean bottom at either Crescent Harbor or Hood Canal EOD Training Ranges. Following the exercise, the anchor is removed.

Seafloor devices have the potential to directly strike fish as they descend below the surface to the point where the anchor strikes the bottom. Fish at and just below the surface, as well as those on the bottom would be most susceptible to injury from strikes because velocity of these materials would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, most water column fishes would have ample time to detect and avoid approaching devices as they fall through the water column. A possibility exists that a small number of fish resting on the bottom may be directly impacted if they are in the target area and near the point of physical impact at the time of seafloor device strike, but the likelihood of one of these objects striking a fish is implausible and in the rare event that a strike occurred, population-level impacts would not occur. Additionally, these activities occur in areas that are frequently used for similar activities, where the bottom type is known and previously disturbed.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, seafloor device use would have no effect on coho, steelhead, bull trout, sockeye, green

sturgeon, and Pacific eulachon critical habitat. Seafloor device use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where devices would be located.

Pursuant to the ESA, the use of seafloor devices during training activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species , Pacific eulachon, green sturgeon and rockfish species.

The use of seafloor devices during training activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon.

Testing Activities

Offshore Area

As indicated in Table 3.9-4, there are five proposed testing activities in the Offshore Area in which seafloor devices are used. These activities involve the testing of unmanned underwater vehicles that crawl across the seafloor. These tests are conducted in the Quinault Range Site only in the surfzone area at Pacific Beach. The crawlers are slow moving and unlikely to impact fish as most fish would have ample time to detect and avoid approaching devices as they crawl across the seafloor. The slow movement of these vehicles and the ability of fish to sense the device in time to avoid it makes it unlikely that any fish would be impacted by these testing activities.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, seafloor device use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of seafloor devices in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where seafloor devices would be used.

Inland Waters

As indicated in Table 3.9-4, there are 210 proposed testing activities in the Inland Waters in which seafloor devices are used. These activities involve the testing of unmanned underwater vehicles that crawl across the seafloor, similar to those described above under Testing Activities – Offshore Area, and also involve tests in which instruments are placed on sea floor. The potential impacts of the unmanned underwater vehicles are the same as described above, and the impacts of the seafloor devices would be similar to those described above for bottom mooring anchors under Training Activities – Inland Waters.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, seafloor device use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Seafloor device use could affect designated nearshore

critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where devices would be located.

Western Behm Canal

As indicated in Table 3.9-4 there are no activities including seafloor devices proposed under the No Action Alternative in Western Behm Canal. Therefore, there would be no impacts to fish, and no effect to ESA-listed species and associated critical habitat.

Pursuant to the ESA, the use of seafloor devices during testing activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

The use of seafloor devices during testing activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, and Pacific eulachon.

3.9.3.3.3.2 Alternative 1

Training Activities

Inland Waters

As indicated in Table 3.9-4, there are 16 proposed training activities under Alternative 1 in the Inland Waters in which seafloor devices are used. The increase from two activities under the No Action Alternative reflects an increase of 4 in the number of EOD mine neutralization exercises in which moored mines might be used, and the addition of 10 precision anchoring exercises. The EOD mine neutralization exercises would be conducted as described above under the No Action Alternative. The precision anchoring exercises would be conducted in two locations; at Naval Station Everett, and at an anchorage site near Indian Island. Both of these locations are historically used for these activities. For the same reasons as described above under the No Action Alternative, it is unlikely that any fish would be impacted by these exercises.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, seafloor device use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Seafloor device use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where devices would be located.

Pursuant to the ESA, the use of seafloor devices during training activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species , Pacific eulachon, green sturgeon, and rockfish species.

The use of seafloor devices during training activities under Alternative 1 may affect, but is not likely to adversely affect, critical habitat for Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon.

Testing Activities

Offshore Area

As indicated in Table 3.9-4, there is an increase in testing activities in the Offshore Area in which seafloor devices are used, from five under the No Action Alternative to six under Alternative 1. These are the same activities as described under Testing Activities – No Action Alternative, and are conducted in the same location. Therefore, the impacts would be the same as described above.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, seafloor device use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of seafloor devices in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where seafloor devices would be used.

Inland Waters

As indicated in Table 3.9-4, there are 225 proposed testing activities in the Inland Waters in which seafloor devices are used, an increase of 15 over the No Action Alternative. These are the same activities as described under Testing Activities – No Action Alternative, and are conducted in the same locations. Therefore, the impacts would be the same as described above.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, seafloor device use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Seafloor device use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where devices would be located.

Western Behm Canal, Alaska

Testing activities including seafloor devices in the Western Behm Canal are proposed to increase from zero annual activities under the No Action Alternative to five under Alternative 1 (Table 3.9-4).

Seafloor devices have the potential to directly strike fish as they descend below the surface to the point where the anchor strikes the bottom. Fish at and just below the surface, as well as those on the bottom would be most susceptible to injury from strikes because velocity of these materials would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, most water column fishes would have ample time to detect and avoid approaching devices as they fall through the water column. A possibility exists that a small number of fish resting on the bottom may be directly impacted if they are in the target area and near the point of physical impact at the time of seafloor device strike, but the likelihood of one of these objects striking a fish is implausible and in the rare event that a strike occurred, population-level impacts would not occur.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, impacts from seafloor devices to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of seafloor devices during testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon and rockfish species.

The use of seafloor devices during testing activities under Alternative 1 may affect, but is not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, and Pacific eulachon.

3.9.3.3.3.3 Alternative 2

Training Activities

Inland Waters

As indicated in Table 3.9-4, there are 16 proposed training activities under Alternative 2 in the Inland Waters in which seafloor devices are used. The increase from two activities under the No Action Alternative reflects an increase of 4 in the number of EOD mine neutralization exercises in which moored mines might be used, and the addition of 10 precision anchoring exercises. The EOD mine neutralization exercises would be conducted as described above under the No Action Alternative. The precision anchoring exercises would be conducted in two locations; at Naval Station Everett, and at an anchorage site near Indian Island. Both of these locations are historically used for these activities. For the same reasons as described above under the No Action Alternative, it is unlikely that any fish would be impacted by these exercises.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, seafloor device use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Seafloor device use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where devices would be located.

Pursuant to the ESA, the use of seafloor devices during training activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species , Pacific eulachon, green sturgeon and rockfish species.

The use of seafloor devices during training activities under Alternative 2 may affect, but is not likely to adversely affect, critical habitat for Chinook and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon..

Testing Activities

Offshore Area

As indicated in Table 3.9-4, there is an increase in testing activities in the Offshore Area in which seafloor devices are used, from five under the No Action Alternative to seven under Alternative 2. These are the same activities as described under Testing Activities – No Action Alternative, and are conducted in the same location. Therefore, the impacts would be the same as described above.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, seafloor device use would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the use of seafloor devices in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where seafloor devices would be used.

Inland Waters

As indicated in Table 3.9-4, there are 239 proposed testing activities in the Inland Waters in which seafloor devices are used, an increase of 29 over the No Action Alternative. These are the same activities as described under Testing Activities – No Action Alternative, and are conducted in the same locations. Therefore, the impacts would be the same as described above.

While seafloor device use could overlap with all of the ESA-listed species, the likelihood of a strike would be extremely low given the low abundance of ESA-listed species in the Study Area, the small area of impacts from seafloor devices in the nearshore areas, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. Therefore, seafloor device use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Seafloor device use could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where devices would be located.

Western Behm Canal, Alaska

Testing activities including seafloor devices in the Western Behm Canal are proposed to increase from 0 annual activities under the No Action Alternative to 15 under Alternative 2 (Table 3.9-4).

Seafloor devices have the potential to directly strike fish as they descend below the surface to the point where the anchor strikes the bottom. Fish at and just below the surface, as well as those on the bottom would be most susceptible to injury from strikes because velocity of these materials would rapidly decrease upon contact with the water and as it travels through the water column. Consequently, most water column fishes would have ample time to detect and avoid approaching devices as they fall through the water column. A possibility exists that a small number of fish resting on the bottom may be directly impacted if they are in the target area and near the point of physical impact at the time of seafloor device strike, but the likelihood of one of these objects striking a fish is implausible and in the rare event that a strike occurred, population-level impacts would not occur.

The ESA-listed species, as summarized in Section 3.9.2.3 (Endangered Species Act-Listed Species), do not overlap with the Western Behm Canal portion of the Study Area. Therefore, impacts from seafloor devices to ESA-listed species from activities in this portion of the Study Area are not expected. Effects to designated critical habitat would not occur as activities do not overlap in Western Behm Canal.

Pursuant to the ESA, the use of seafloor devices during testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species , Pacific eulachon, green sturgeon and rockfish species.

The use of seafloor devices during testing activities under Alternative 2 may affect, but is not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, and Pacific eulachon.

3.9.3.3.3.4 Summary and Conclusions of Physical Disturbance and Strike Impacts

The greatest potential for combined impacts of physical disturbance and strike stressors under the Proposed Action would occur for SINKEX because of multiple opportunities for potential strike by vessel, ordnance, or other military expended material. However, SINKEX described under the No Action Alternative are not proposed under Alternative 1 or Alternative 2.

A less intensive example of potential impacts of combined strike stressors would be for cases where a fish could be displaced by a vessel in the water column during any number of activities utilizing bombs, missiles, rockets, or projectiles. As the vessel maneuvers during the exercise, any fishes displaced by that vessel movement could potentially be struck by munitions expended by that vessel during that same exercise. This would be more likely to occur in concentrated areas of this type of activity (e.g., a GUNEX exercise inside a gunnery box). However, the likelihood of this occurring is probably quite low anywhere else because most activities do not expend their munitions towards, or in proximity to, a training or testing vessel for safety reasons. While small-caliber projectiles are expended away from but often close to the vessel from which the projectiles are fired, this does not necessarily increase the risk of strike. During the initial displacement of the fish from vessel activity or after the first several projectiles are fired, most fishes would disperse widely and the probability of strike may actually be reduced in most cases. Also, the combination of these stressors would cease immediately when the activity ends; therefore, combination is possible but not reasonably foreseeable.

3.9.3.3.3.5 Summary of Physical Disturbance and Strike Stressors and General Conclusions

Exposures to physical disturbance and strike stressors occur primarily within the range complexes and operating areas associated with the Study Area. Research suggests that only a limited number of marine fish species are susceptible to being struck by a vessel. Most fishes would not respond to vessel disturbance beyond a temporary displacement from their normal activity, which would be discountable. The Navy identified and analyzed three physical disturbance or strike sub-stressors that have potential to impact fishes: vessel and in-water device strikes, military expended material strikes, and seafloor device strikes. While the potential for vessel strikes on fish can occur anywhere vessels are operated, most fishes are highly mobile and capable of avoiding vessels, expended materials, or objects in the water column. For the larger slower-moving species (e.g., basking shark, manta ray, and ocean sunfish) the potential for a vessel or military expended material strike increases, as discussed in the analysis. The potential for a seafloor device striking a fish is very low because the sensory capabilities of most fishes allow them to detect and avoid underwater objects. For rockfish and green sturgeon species that are

bottom dwellers, seafloor devices may have an adverse affect; however, it is still unlikely due to the fish's sensory capabilities.

Pursuant to the ESA, physical disturbance and strikes under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but is not likely to adversely affect, *ESA-listed salmonid species , Pacific eulachon, green sturgeon and rockfish species.*

Physical disturbance and strikes under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, and Pacific eulachon.

3.9.3.4 Entanglement Stressors

This section evaluates potential entanglement impacts of various types of expended materials used by the Navy during training and testing activities within the Study Area. The likelihood of fish being affected by an entanglement stressor is a function of the physical properties, location, and buoyancy of the object and the behavior of the fish. Two types of military expended materials are considered here: (1) fiber optic cables and guidance wires and (2) decelerator/parachutes.

Most entanglement observations involve abandoned or discarded nets, lines, and other materials that form loops or incorporate rings (Derraik 2002; Keller et al. 2010; Laist 1987; Macfadyen et al. 2009). A 25-year dataset assembled by the Ocean Conservancy reported that fishing line, rope, and fishing nets accounted for approximately 68 percent of fish entanglements, with the remainder due to encounters with various items such as bottles, cans, and plastic bags (Ocean Conservancy 2010). No occurrences involving military expended materials were documented.

Fish entanglement occurs most frequently at or just below the surface or in the water column where objects are suspended. A smaller number involve objects on the seafloor, particularly abandoned fishing gear designed to catch bottom fish or invertebrates (Ocean Conservancy 2010). More fish species are entangled in coastal waters and the continental shelf than elsewhere in the marine environment because of higher concentrations of human activity (e.g., fishing, sources of entangling debris), higher fish abundances, and greater species diversity (Helfman et al. 2009b; Macfadyen et al. 2009).

The consequences of entanglement range from temporary and inconsequential to major physiological stress or mortality. Some fish are more susceptible to entanglement in derelict fishing gear and other marine debris, compared to other fish groups. Physical features, such as rigid or protruding snouts of some elasmobranchs (e.g., the wide heads of hammerhead sharks), increase the risk of entanglement compared to fish with smoother, more streamlined bodies (e.g., lamprey and eels). Most other fish, except for jawless fish and eels that are too smooth and slippery to become entangled, are susceptible to entanglement gear specifically designed for that purpose (e.g., gillnets); however, the Navy does not expend any items that are designed to function as entanglement objects.

The overall effects of entanglement are highly variable, ranging from temporary disorientation to mortality due to predation or physical injury. The evaluation of a species' entanglement potential should consider the size, location, and buoyancy of an object as well as the behavior of the fish species.

The following sections seek to identify entanglement potential due to military expended material. Where appropriate, specific geographic areas (open ocean areas, range complexes, testing ranges, and bays and Inland Waters) of potential impact are identified.

3.9.3.4.1 Impacts from Fiber Optic Cables and Guidance Wires

Fiber optic cables and guidance wires are used during training and testing activities. A discussion of the types of activities, physical characteristics, location of use, and the number of items expended under each alternative is presented in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires).

Marine fish groups identified in Section 3.9.2 (Affected Environment) that could be susceptible to entanglement in expended fiber optic cables and guidance wires are those with elongated snouts lined with tooth-like structures that easily snag on other similar marine debris, such as derelict fishing gear (Macfadyen et al. 2009). Species occurring outside the specified areas within the range complexes would not be exposed to fiber optic cables or guidance wires.

Once a guidance wire is released, it is likely to sink immediately and remain on the seafloor. In some cases, the wire may snag on a hard structure near the bottom and remain partially or completely suspended. The types of fish that encounter any given wire would depend, in part, on its geographic location and vertical location in the water column. In any situation, the most likely mechanism for entanglement would involve fish swimming through loops in the wire that tighten around it; however, loops are unlikely to form in guidance wire (Environmental Sciences Group 2005).

Because of their physical characteristics, guidance wires and fiber optic cables pose a potential, though unlikely, entanglement risk to susceptible fish. Potential entanglement scenarios are based on fish behavior in abandoned monofilament, nylon, and polypropylene lines used in commercial nets. Such derelict fishing gear is abundant in the ocean (Macfadyen et al. 2009) and poses a greater hazard to fish than the very thin wire expended by the Navy. Fishing gear materials often have breaking strengths that can be up to orders of magnitude greater than that of guidance wire and fiber optic cables (Environmental Sciences Group 2005) and are far more prone to tangling, as discussed in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires). Fiber optic cables do not easily form loops, are brittle, and break easily if bent, so they pose a negligible entanglement risk. Additionally, the encounter rate and probability of impact from guidance wires and fiber optic cables are low, as few are expended and, therefore, have limited overlap with sturgeon.

No training or testing activities with fiber optic cables and guidance wires would be proposed in the Western Behm Canal portion of the Study Area under any alternative. Therefore, there would be no impacts from fiber optic cables and guidance wires under any alternative.

3.9.3.4.1.1 No Action Alternative

Training Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under the No Action Alternative, two activities that expend fiber optic cables or expended guidance wires would occur in the Offshore Area. While individual fish susceptible to entanglement could encounter guidance wires and cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited in this area, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into nearshore and coastal areas where the ESA-listed species are found or into designated river or estuarine critical habitat. Therefore, fiber optic cables and guidance wires would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by fiber optic cables and guidance wires in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Inland Waters

As shown in Table 3.9-4, no fiber optic cables or guidance wires would be expended under the No Action Alternative in the Inland Waters of the Study Area for training activities. Therefore, there would be no impacts from fiber optic cables or guidance wires from the No Action Alternative in the Inland Waters of the Study Area.

Pursuant to the ESA, the use of fiber optic cables and guidance wires for training activities under the No Action Alternative may affect, but is not likely to adversely affect, *ESA-listed salmonid species , Pacific eulachon, green sturgeon and rockfish species..*

The use of fiber optic cables and guidance wires for training activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for green sturgeon; and would have no effect on critical habitat for chum, Chinook, coho, steelhead, bull trout, sockeye, and Pacific eulachon.

Testing Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. All expenditures of fiber optic cables and guidance wires (16 total) in the Offshore Area result from NAVSEA torpedo testing.

While individual fish susceptible to entanglement could encounter guidance wires and cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into nearshore and coastal areas where the

designated river or estuarine critical habitat is located. Therefore, fiber optic cables and guidance wires would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by fiber optic cables and guidance wires in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Inland Waters

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. All expenditures of fiber optic cables and guidance wires in the Inland Waters result from NAVSEA torpedo testing. Under the No Action Alternative, 105 fiber optic cables and guidance wires would be expended in the Inland Waters.

While individual fish susceptible to entanglement could encounter guidance wires and cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into the designated river or estuarine critical habitat. Therefore, expended fiber optic cables and guidance wires would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended fiber optic cables and guidance wires could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Pursuant to the ESA, the use of fiber optic cables and guidance wires for testing activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species , Pacific eulachon, green sturgeon and rockfish species.

The use of fiber optic cables and guidance wires for testing activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for green sturgeon; and would have no effect on critical habitat for chum, Chinook, coho, steelhead, bull trout, sockeye, and Pacific eulachon.

3.9.3.4.1.2 Alternative 1

Training Activities

Offshore Area

As shown in Table 3.9-4, no fiber optic cables or guidance wires would be expended in the Offshore Area under Alternative 1; therefore, there would be no impact to fish.

Inland Waters

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 1, there would be one fiber optic cables or guidance wire expended in the Inland Waters. Under Alternative 1, the civilian port defense exercise that would occur once every other year within the Inland Waters would result in the expenditure of a fiber optic cable.

While individual fish susceptible to entanglement could encounter guidance wires and cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into the designated river or estuarine critical habitat. Therefore, expended fiber optic cables and guidance wires would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended fiber optic cables and guidance wires could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land..

Pursuant to the ESA, the use of fiber optic cables and guidance wires *for training activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.*

The use of fiber optic cables and guidance wires for training activities in the Inland Waters of the Study Area under Alternative 1 may affect, but is not likely to adversely affect, nearshore critical habitat for Chinook and chum salmon; and would have no effect on critical habitat for Pacific eulachon, green sturgeon, coho, steelhead, bull trout, and sockeye.

Testing Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. All expenditures of fiber optic cables and guidance wires in the Offshore Area result from NAVSEA torpedo testing. Under Alternative 1, 20 fiber optic cables and guidance wires would be expended in the Offshore Area, an increase of four from the No Action Alternative.

The potential impacts of expended fiber optic cables and guidance wires would be short term and temporary for the same reasons stated under the analysis under the No Action Alternative for testing activities.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into nearshore and coastal areas where the designated river or estuarine critical habitat is located. Therefore, fiber optic cables and guidance wires would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by fiber optic cables and guidance wires in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Inland Waters

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. All expenditures of fiber optic cables and guidance wires in the Inland Waters result from NAVSEA torpedo testing. Under the Alternative 1, 122 fiber optic cables and guidance wires would be expended in the Inland Waters, compared to 105 under the No Action Alternative.

The potential impacts of expended fiber optic cables and guidance wires would be short term and temporary for the same reasons stated under the analysis under the No Action Alternative for testing activities.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors), and are outside the Study Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into the designated river or estuarine critical habitat. Therefore, expended fiber optic cables and guidance wires would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended fiber optic cables and guidance wires could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Pursuant to the ESA, the use of fiber optic cables and guidance wires for testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of fiber optic cables and guidance wires for testing activities under Alternative 1 may affect, but is not likely to adversely affect, nearshore critical habitat for green sturgeon, Chinook, and chum salmon; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, or sockeye.

3.9.3.4.1.3 Alternative 2

Training Activities

Offshore Area

As shown in Table 3.9-4, no fiber optic cables or guidance wires would be expended in the Offshore Area under Alternative 2; therefore, there would be no impact to fish.

Inland Waters

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 2, there would be one activity that expend either fiber optic cables or guidance wires in the Inland Waters. Under Alternative 2, the Civilian Port Defense Exercise that would occur once every year within the Inland Waters would result in the expenditure of a fiber optic cable. This is an increase of one fiber optic cable per year; therefore, impacts under Alternative 2 would be similar to those described in Alternative 1. The risk of entanglement resulting from proposed training activities would be low as described in the analysis for Alternative 1.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into nearshore and coastal areas where the designated river or estuarine critical habitat is located. Therefore, expended fiber optic cables and guidance wires would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended fiber optic cables and guidance wires could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land..

Pursuant to the ESA, the use of fiber optic cables and guidance wires for training activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of fiber optic cables and guidance wires for training activities under Alternative 2 may affect, but is not likely to adversely affect, nearshore critical habitat for green sturgeon, Chinook, and chum salmon and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

Testing Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. All expenditures of fiber optic cables and guidance wires in the Offshore Area result from NAVSEA torpedo testing. Under Alternative 2, 24 fiber optic cables and guidance wires would be expended in the Offshore Area, an increase of eight from the No Action Alternative.

The potential impacts of expended fiber optic cables and guidance wires would be short term and temporary for the same reasons stated under the analysis under the No Action Alternative for testing activities.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into nearshore and coastal areas where the designated river or estuarine critical habitat is located. Therefore, fiber optic cables and guidance wires would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by fiber optic cables and guidance wires in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Inland Waters

Table 3.9-4 lists the number and locations of expended fiber optic cables and guidance wires. All expenditures of fiber optic cables and guidance wires in the Inland Waters result from NAVSEA torpedo testing. Under the Alternative 1, 122 fiber optic cables and guidance wires would be expended in the Inland Waters, compared to 105 under the No Action Alternative.

The potential impacts of expended fiber optic cables and guidance wires would be short term and temporary for the same reasons stated under the analysis under the No Action Alternative for testing activities.

While expended fiber optic cables and guidance wires could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, the properties of guidance wires and fiber optic cables reduce entanglement risk to fish, and the dispersed nature of the activity. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. The sink rates of these guidance wires would rule out the possibility of it drifting great distances into nearshore and coastal areas where the designated river or estuarine critical habitat is located. Therefore, expended fiber optic cables and guidance wires would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended fiber optic cables and guidance wires could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and displacement of sediments where fiber optic cables and guidance wires land.

Pursuant to the ESA, the use of fiber optic cables and guidance wires for testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of fiber optic cables and guidance wires for testing activities under Alternative 2 may affect, but is not likely to adversely affect, nearshore critical habitat for green sturgeon, Chinook, and chum salmon; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

3.9.3.4.2 Impacts from Decelerator/Parachutes

Decelerator/parachutes of varying sizes are used during training and testing activities. The types of activities that use decelerator/parachutes, physical characteristics and size of decelerator/parachutes, locations where decelerator/parachutes are used, and the number of decelerator/parachute activities proposed under each alternative are presented in Section 3.0.5.3.4.2 (Decelerator/parachutes).

Fish face many potential entanglement scenarios in abandoned monofilament, nylon, polypropylene line, and other derelict fishing gear in the nearshore and offshore marine habitats of the Study Area (Macfadyen et al. 2009; Ocean Conservancy 2010). Abandoned fishing gear is dangerous to fish because it is abundant, essentially invisible, strong, and easily tangled. In contrast, decelerator/parachutes are rare, highly visible, and not designed to capture fish. The combination of low encounter rates and weak entangling features reduce the risk that salmonid species would be adversely impacted by decelerator/parachutes.

Once a decelerator/parachute has been released to the water, it poses a potential entanglement risk to fish. The Naval Ocean Systems Center identified the potential impacts of torpedo air launch accessories, including decelerator/parachutes, on fish (U.S. Department of the Navy 1996). Unlike other materials in which fish become entangled (such as gill nets and nylon fishing line), the decelerator/parachute is relatively large and visible, reducing the chance that visually oriented fish would accidentally become entangled in it. No cases of fish entanglement have been reported for decelerator/parachutes (Ocean Conservancy 2010; U.S. Department of the Navy 2001a). Entanglement in a newly-expended decelerator/parachute while it is in the water column is unlikely because fish generally react to sound and motion at the surface with a behavioral reaction by swimming away from the source (see Section 3.9.3.3.2, Impacts from Military Expended Materials) and would detect the oncoming decelerator/parachute in time to avoid contact. While the decelerator/parachute is sinking, fish would have ample opportunity to swim away from the large moving object. Once the decelerator/parachute is on the bottom; however, it is feasible that a fish could become entangled in the decelerator/parachute or its suspension lines while diving and feeding, especially in deeper waters where it is dark. If the decelerator/parachute dropped in an area of strong bottom currents, it could billow open and pose a short-term entanglement threat to large fish feeding on the bottom. Benthic fish with elongated spines could become caught on the decelerator/parachute or lines. Most sharks and other smooth-bodied fish are not expected to become entangled because their soft, streamlined bodies can more easily slip through potential snares. A fish with spines or protrusions (e.g., some sharks, billfish, sturgeon, or sawfish) on its body that swam into the decelerator/parachute or a loop in the lines and then struggled could become bound tightly enough to prevent escape. Although this scenario is possible based on the structure of the materials and the shape and behavior of fish, it is not considered a likely event.

Aerial-launched sonobuoys are deployed with a decelerator/parachute. The sonobuoy itself is not considered an entanglement hazard upon deployment (Environmental Sciences Group 2005), but its components may pose an entanglement hazard once released into the ocean. Sonobuoys contain cords, electronic components, and plastic mesh that may entangle fish (Environmental Sciences Group 2005). Open-ocean filter feeding species, such as basking sharks, whale sharks, and manta rays could become entangled in these items, whereas smaller species could become entangled in the plastic mesh in the same manner as a small gillnet. Since most sonobuoys are expended in offshore areas, many coastal fish would not encounter or have any opportunity to become entangled in materials associated with sonobuoys, apart from the risk of entanglement in decelerator/parachutes described above.

No training or testing activities with decelerator/parachutes would be proposed in the Western Behm Canal under any alternative. Therefore, there would be no impact from decelerator/parachutes in the Western Behm Canal under any Alternative.

3.9.3.4.2.1 No Action Alternative

Training Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under the No Action Alternative, the Navy proposes to conduct training activities that would result in the expenditure of approximately 8,400 decelerator/parachutes. This expenditure of decelerator/parachutes is almost entirely due to training in which sonobuoys and their accompanying decelerator/parachutes are deployed. The number and footprint of decelerator/parachutes are detailed in Table 3.3-4. As indicated in Section 3.0.5.3.4.2 (Decelerator/parachutes) under the No Action Alternative, activities involving decelerator/parachute use would occur in the open ocean portions of Offshore Area of the Study Area. Given the size of the range complexes and the widely scattered use of decelerator/parachutes (0.02 per nm^2, it would be very unlikely that fishes would encounter and become entangled in any decelerator/parachutes or sonobuoy accessories. If a fish were to encounter and become entangled in any of these items, the growth, survival, annual reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for training activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, decelerator/parachutes would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by decelerator/parachutes in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Inland Waters

No training activities with decelerator/parachutes are proposed in the Inland Waters portion of the Study Area under the No Action Alternative. Therefore, decelerator/parachutes would have no impact on fish under the No Action Alternative.

Pursuant to the ESA, the use of decelerator/parachutes for training activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of decelerator/parachutes for training activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for green sturgeon; and would have no effect on critical habitat for Chinook, chum, coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under the No Action Alternative, the Navy proposes to conduct testing activities that would result in the expenditure of approximately 17 decelerator/parachutes. This expenditure of decelerator/parachutes is due to NAVSEA torpedo testing. The number and footprint of decelerator/parachutes are detailed in Table 3.3-4. As indicated in Section 3.0.5.3.4.2 (Decelerator/parachutes) under the No Action Alternative, activities involving decelerator/parachute use would occur in the Quinault Range Site. Given the size of the range complex and the resulting widely scattered decelerator/parachutes (0.02 per nm^2), it would be very unlikely that fishes would encounter and become entangled in any decelerator/parachutes or sonobuoy accessories. If a fish were to encounter and become entangled in any of these items, the growth, survival, annual reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for testing activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, decelerator/parachutes would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by decelerator/parachutes in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Inland Waters

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under the No Action Alternative, the Navy proposes to conduct testing activities that would result in the expenditure of four decelerator/parachutes in the Inland Waters. This expenditure of decelerator/parachutes is due to NAVSEA torpedo testing. Given the low number of decelerator/parachutes expended each year, it would be very unlikely that fishes would encounter and become entangled in any decelerator/parachutes or sonobuoy accessories. If a fish were to encounter and become entangled in any of these items, the growth, survival, annual reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for

testing activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, decelerator/parachutes would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended decelerator/parachutes could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and covering of habitats where decelerator/parachutes settle..

Pursuant to the ESA, the use of decelerator/parachutes for testing activities under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of decelerator/parachutes for testing activities under the No Action Alternative may affect, but is not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

3.9.3.4.2.2 Alternative 1

Training Activities

Offshore Area

The number of expended decelerator/parachutes used under Alternative 1 would be the same as those used under the No Action Alternative and would have the same impacts as described under the No Action Alternative.

Inland Waters

No training activities with decelerator/parachutes are proposed in the Inland Waters portion of the Study Area under Alternative 1. Therefore, decelerator/parachutes would have no impact on fish under Alternative 1.

Pursuant to the ESA, the use of decelerator/parachutes for training activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of decelerator/parachutes for training activities under Alternative 1 may affect, but is not likely to adversely affect, critical habitat for green sturgeon; and would have no effect on critical habitat for Pacific eulachon, chum, Chinook, coho, steelhead, bull trout, and sockeye.

Testing Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under Alternative 1, the Navy proposes to conduct testing activities that would result in the expenditure of approximately 1,230 decelerator/parachutes, compared to 17 under the No Action Alternative. This increase compared with the No Action Alternative is due to the addition of NAVAIR sonobuoy testing activities (Table 2.8-3), which would typically occur in deep waters offshore. Given the size of the range complexes and the resulting widely scattered decelerator/parachutes (0.03 per nm^2), it would be very unlikely that fishes would encounter and become entangled in any decelerator/parachutes or sonobuoy accessories. If a fish were to encounter and become entangled in any of these items, the growth, survival, annual

reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for testing activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, decelerator/parachutes would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by decelerator/parachutes in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Inland Waters

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under Alternative 1, the Navy proposes to conduct testing activities that would result in the expenditure of four decelerator/parachutes in the Inland Waters, the same as proposed under the No Action Alternative. Therefore, the risk of entanglement from decelerator/parachutes would be the same as described above under the No Action Alternative.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for testing activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, decelerator/parachutes would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended decelerator/parachutes could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Pursuant to the ESA, the use of decelerator/parachutes for testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of decelerator/parachutes for testing activities under Alternative 1 may affect, but is not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

3.9.3.4.2.3 Alternative 2

Training Activities

Offshore Area

The number of expended decelerator/parachutes used under Alternative 2 would be the same as those used under the No Action Alternative, and would therefore have the same impacts as described under the No Action Alternative.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for training activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, decelerator/parachutes would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by decelerator/parachutes in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Inland Waters

No training activities with decelerator/parachutes are proposed in the Inland Waters portion of the Study Area under Alternative 2. Therefore, decelerator/parachutes would have no impact on fish under Alternative 2.

Pursuant to the ESA, the use of decelerator/parachutes for training activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of decelerator/parachutes for training activities under Alternative 2 may affect, but is not likely to adversely affect, critical habitat for green sturgeon; and would have no effect on critical habitat for Chinook, chum, coho, steelhead, bull trout, and sockeye or Pacific eulachon.

Testing Activities

Offshore Area

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under Alternative 2, the Navy proposed to conduct testing activities that would result in the expenditure of approximately 1,350 decelerator/parachutes, compared to 17 under the No Action Alternative. This increase compared with the No Action Alternative is due to the addition of NAVAIR sonobuoy testing activities (Table 2.8-3), which would typically occur in deep waters offshore.

Given the size of the range complexes and the resulting widely scattered decelerator/parachutes (0.03 per nm^2), it would be very unlikely that fishes would encounter and become entangled in any decelerator/parachutes or sonobuoy accessories. If a fish were to encounter and become entangled in any of these items, the growth, survival, annual reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for training activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, decelerator/parachutes would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by decelerator/parachutes in the Offshore Area; however, any impacts would be short-term and localized disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Inland Waters

Table 3.9-4 lists the number and locations of expended decelerator/parachutes. Under Alternative 2, the Navy proposes to conduct testing activities that would result in the expenditure of five decelerator/parachutes in the Inland Waters. Given the low number of decelerator/parachutes expended, and the similarity to the number proposed under the No Action Alternative (increase of one decelerator/parachute per year), the risk of entanglement from decelerator/parachutes would be the same as described above under the No Action Alternative.

While decelerator/parachutes could overlap with all of the ESA-listed species, the likelihood of entanglement would be extremely low given the low abundance of ESA-listed species in the Study Area, and the density of decelerator/parachutes expended. However, if an expended decelerator/parachute drifted into an area where these species were encountered, the salmonid species and Pacific eulachon are strong swimmers with streamlined bodies that are unlikely to become entangled in decelerator/parachutes or lines. The rockfish species and green sturgeon would be more likely to become entangled in a decelerator/parachute; however, based on the analysis in Section 3.9.3.4.2 (Impacts from Decelerator/parachutes), and the location of expended decelerator/parachutes for testing activities, such an event is unlikely. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, decelerator/parachutes would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. Expended decelerator/parachutes could affect designated nearshore critical habitat for Chinook and chum in the Inland Waters. However, any impacts are expected to be localized and temporary disturbances of the water column and covering of habitats where decelerator/parachutes settle.

Pursuant to the ESA, the use of decelerator/parachutes for testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The use of decelerator/parachutes for testing activities under Alternative 2 may affect, but is not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, and sockeye or Pacific eulachon.

3.9.3.4.3 Summary and Conclusions of Entanglement Impacts

While most fish species are susceptible to entanglement in fishing gear that is designed to entangle a fish by trapping a fish by its gills or spines (e.g., gill nets), only a limited number of fish species that possess certain features such as an irregular shaped or rigid rostrum (snout) (e.g., billfish) are susceptible to entanglement by military expended materials.

3.9.3.4.3.1 Combined Entanglement Stressors

An individual fish could experience the following consequences of entanglement stressors: displacement, stress, avoidance response, behavioral changes, increased predation, entanglement causing injury, and entanglement causing mortality. If entanglement results in mortality, it cannot act in combination because mortal injuries occur with the first instance. Therefore, there is no possibility for the occurrence of this consequence to increase if sub-stressors are combined.

Sub-lethal consequences may result in delayed mortality because they cause irrecoverable injury or alter the individual's ability to feed or detect and avoid predation. Sub-lethal effects resulting in mortality could be more likely if the activities occurred in essentially the same location and occurred within the individual's recovery time from the first disturbance. This circumstance is only likely to arise during training and testing activities that cause frequent and recurring entanglement stressors to essentially the same location (e.g., torpedoes expended at the same location as sonobuoys). In these specific circumstances, the potential consequences to fishes from combinations of entanglement stressors may be greater than the sum of their individual consequences.

These specific circumstances that could multiply the consequences of entanglement stressors are highly unlikely to occur for two reasons. First, it is highly unlikely that torpedo guidance wires and sonobuoy decelerator/parachutes would impact essentially the same space and the same individual fish because most of these sub-stressors are widely dispersed in time and space. Because the risk of injury or mortality is extremely low for each sub-stressor independently, the combined impact of these sub-stressors does not increase the risk in a meaningful way. Furthermore, while it is conceivable that interaction between sub-stressors could magnify their combined risks, the necessary circumstances are highly unlikely to overlap.

Interaction between entanglement sub-stressors is likely to have neutral consequences for fishes. There is no potential for these entangling objects to combine in a way that would multiply their impact, as is the case with derelict (abandoned or discarded) fishing nets that commonly occur in the Study Area (Macfadyen et al. 2009) and entangle fish by design. Fish entangled in derelict nets attract scavengers and predators that may themselves become entangled in an ongoing cycle (Morgan and Chuenpagdee 2003). Guidance wires and decelerator/parachutes are used relatively infrequently over a wide area, and are mobile for only a short time. Therefore, unlike discarded fishing gear, it is extremely unlikely that guidance wires and decelerator/parachutes could interact.

3.9.3.4.3.2 Summary of Entanglement Stressors

The Navy identified and analyzed two military expended materials types that have potential to entangle fishes: cables and wires, and decelerator/parachutes. Other military expended materials types such as bomb or missile fragments do not have the physical characteristics to entangle fishes in the marine environment and were not analyzed. Even for fishes that might encounter and become entangled in an expended torpedo wire, the breaking strength of that wire is low enough that the impact would be only temporary and not likely to cause harm to the individual. Given the low number of decelerator/parachutes expended, it would be very unlikely that fishes would encounter and become entangled in any decelerator/parachutes or sonobuoy accessories. If a fish were to encounter and become entangled in any of these items, the growth, survival, annual reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

Pursuant to the ESA, entanglement stressors used under the No Action Alternative, Alternative 1, and Alternative 2 may affect, but are not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Entanglement stressors used under the No Action Alternative, Alternative 1, and Alternative 2 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for coho, steelhead, bull trout, and sockeye or Pacific eulachon.

3.9.3.5 Ingestion Stressors

This section analyzes the potential ingestion impacts of the various types of munitions and military expended materials other than munitions used by the Navy during training and testing activities within the Study Area. Aspects of ingestion stressors that are applicable to marine organisms in general are presented in Section 3.0.5.3.5 (Ingestion Stressors). Ingestion of expended materials by fishes could occur in coastal and open ocean areas and can occur at the surface, in the water column, or at the seafloor depending on the size and buoyancy of the expended object and the feeding behavior of the fish. Floating material is more likely to be eaten by fishes that feed at or near the water surface (e.g., ocean sunfishes, basking sharks, etc.), while materials that sink to the seafloor present a higher risk to bottom-feeding fishes (e.g., rockfish, skates/rays, flounders).

It is reasonable to assume that any item of a size that can be swallowed by a fish could be eaten at some time; this analysis focuses on ingestion of materials in two locations: (1) at the surface or water column, and (2) at the seafloor. Open-ocean predators and open-ocean planktivores are most likely to ingest materials in the water column. Coastal bottom-dwelling predators and estuarine Inland Waters bottom-dwelling predators could ingest materials from the seafloor. The potential for fish, including the ESA-listed fish species, to encounter and ingest expended materials is evaluated with respect to their feeding group and geographic range, which influence the probability that they would eat military expended materials.

The Navy expends the following types of materials during training and testing in the Study Area that could become ingestion stressors: non-explosive practice munitions (small- and medium-caliber), fragments from high-explosives, fragments from targets, chaff, flare casings (including plastic end caps and pistons), and small decelerator/parachutes. The activities that expend these items and their general distribution are detailed in Section 3.0.5.3.5 (Ingestion Stressors). Metal items eaten by marine fish are generally small (such as fishhooks, bottle caps, and metal springs), suggesting that small- and medium-caliber projectiles, pistons, or end caps (from chaff canisters or flares) are more likely to be ingested.

Both physical and toxicological impacts could occur as a result of consuming metal or plastic materials. Items of concern are those of ingestible size that either drift at or just below the surface (or in the water column) for a time or sink immediately to the seafloor. The likelihood that expended items would cause a potential impact on a given fish species depends on the size and feeding habits of the fish and the rate at which the fish encounters the item and the composition of the item. In this analysis only small- and medium-caliber munitions (or small fragments from larger munitions), chaff, small decelerator/parachutes, and end caps and pistons from flares and chaff cartridges are considered to be of ingestible size for a fish.

The analysis of ingestion impacts on fish is structured around the following feeding strategies:

Feeding at or Just Below the Surface or Within the Water Column

- **Open-Ocean Predators.** Large, migratory, open-ocean fishes, such as dorado, sharks, and billfishes feed on fast-swimming prey in the water column of the Study Area (Table 3.9-6). These fishes range widely in search of unevenly distributed food patches. The ESA-listed salmonid species and eulachon fall into this category. Smaller military expended materials could be mistaken for prey items and ingested purposefully or incidentally as the fish is swimming.
- **Open-Ocean Planktivores.** Plankton eating fish in the open-ocean portion of the Study Area include anchovies, sardines, flying fishes, ocean sunfish, and basking sharks (Table 3.9-6). These fishes feed by either filtering plankton from the water column or by selectively ingesting larger zooplankton. These planktivores could encounter and incidentally feed on smaller types of military expended materials (e.g., chaff, end caps, pistons) at the surface or in the water column. None of the species listed under the ESA in the Study Area are open ocean planktivores, but some species in this group of fishes (e.g., anchovies) constitute a major prey base for many important predators.

Military expended materials that could potentially impact these types of fish at or just below the surface or in the water column include those items that float or are suspended in the water column for some period of time (e.g., decelerator/parachutes and end caps and pistons from chaff cartridges or flares). Military expended materials that could be ingested by fish at the seafloor include items that sink (e.g., small-caliber projectiles and casings, fragments from high-explosive munitions).

Fishes Feeding at the Seafloor

- **Coastal Bottom Dwelling Predators/Scavengers.** Large predatory fishes near the seafloor are represented by rockfishes, groupers, and jacks, which are typical seafloor predators in coastal and deeper nearshore waters of the Study Area (see Table 3.9-6). These species feed opportunistically on or near the bottom, taking fish and invertebrates from the water column and from the seafloor (e.g., crabs, octopus). Bottom-dwelling fishes in the nearshore coasts (see Table 3.9-6) may feed by seeking prey and by scavenging on dead fishes and invertebrates (e.g., skates, rays, flatfish, rat fish). The ESA-listed rockfish species (bocaccio, canary rockfish, and yelloweye rockfish) and green sturgeon are all bottom dwelling predators.

Table 3.9-6: Summary of Ingestion Stressors on Fishes Based on Location

Feeding Guild	Representative Species	ESA-Protected Species	Overall Potential for Impact
Offshore Area: Open-ocean Predators	Dorado, most shark species, billfish	Salmonids, Pacific eulachon	These fishes may eat floating or sinking expended materials, but the encounter rate would be extremely low.
Offshore Area: Open-ocean plankton eaters	Basking shark	None	These fishes may ingest floating expended materials incidentally as they feed in the water column, but the encounter rate would be extremely low.
Offshore Area and Inland Waters: Coastal bottom-dwelling predators	Rockfishes, groupers, jacks	Bocaccio, canary rockfish, yelloweye rockfish	These fishes may eat expended materials on the seafloor, but the encounter rate would be extremely low.
Offshore Area and Inland Waters: Coastal/estuarine bottom-dwelling predators and scavengers	Skates and rays, flounders	Green sturgeon	These fishes could incidentally eat some expended materials while foraging, especially in muddy waters with limited visibility. However, encounter frequency would be extremely low.

Note: ESA = Endangered Species Act

Potential impacts of ingestion to adults are different than for other lifestages (eggs, larvae, juveniles) because early lifestages are too small to ingest any military expended materials except for chaff. Therefore, no ingestion potential impacts on early lifestages would occur with the exception of later stage larvae and juveniles.

Within the context of fish location in the water column and feeding strategies, the analysis is divided into (1) munitions (small- and medium-caliber projectiles, and small fragments from larger munitions); and (2) military expended material other than munitions (chaff, chaff end caps, pistons, decelerator/parachutes, flares, and target fragments).

3.9.3.5.1 Impacts from Ingestion of Munitions and Military Expended Materials Other than Munitions

The potential impacts of ingesting foreign objects on a given fish depend on the species and size of the fish. Fish that normally eat spiny, hard-bodied invertebrates could be expected to have tougher mouths and digestive systems than fish that normally feed on softer prey. Materials that are similar to the normal diet of a fish would be more likely to be ingested and more easily handled once ingested—for example, by fish that feed on invertebrates with sharp appendages. These items could include fragments from high-explosives that a fish could encounter on the seafloor. Relatively small or smooth objects, such as small caliber projectiles or their casings, might pass through the digestive tract without causing harm. A small sharp-edged item could cause a fish immediate physical distress by tearing or cutting the mouth, throat, or stomach. If the object is rigid and large (relative to the fish's mouth and throat), it may block the throat or obstruct the flow of waste through the digestive system. An object may be enclosed by a cyst in the gut lining (Danner et al. 2009; Hoss and Settle 1990). Ingestion of large foreign objects could lead to disruption of a fish's normal feeding behavior, which could be sublethal or lethal.

Munitions are heavy and would sink immediately to the seafloor, so exposure would be limited to those fish identified as bottom-dwelling predators and scavengers. It is possible that expended small caliber projectiles on the seafloor could be colonized by seafloor organisms and mistaken for prey or that expended small caliber projectiles could be accidentally or intentionally eaten during foraging. Over time, the metal may corrode or become covered by sediment in some habitats, reducing the likelihood of a fish encountering the small caliber, non-explosive practice munitions.

Fish feeding on the seafloor in the offshore locations where these items are expended (e.g., gunnery boxes) would be more likely to encounter and ingest them than fish in other locations. A particularly large item (relative to the fish ingesting it) could become permanently encapsulated by the stomach lining, with the rare chance that this could impede the fish's ability to feed or take in nutrients. However, in most cases, a fish would pass a round, smooth item through its digestive tract and expel it, with no long-term measurable reduction in the individual's fitness (Danner et al. 2009; Hoss and Settle 1990).

If high-explosive ordnance does not explode, it would sink to the bottom. In the unlikely event that explosive material, high-melting-point explosive (known as HMX) or royal demolition explosive (known as RDX), is exposed on the ocean floor it would break down in a few hours (U.S. Department of the Navy 2001b). HMX or RDX would not accumulate in the tissues of fish (Lotufo et al. 2010; Price et al. 1998). Fish may take up trinitrotoluene (TNT) from the water when it is present at high concentrations but not from sediments (Lotufo et al. 2010). As described in Section 3.1.3.1.5.2 (Unexploded Ordnance) of this EIS/OEIS, most studies of unexploded ordnance in marine environments have not detected explosives or have detected them in very minute concentrations. The rapid dispersal and dilution of TNT expected in the marine water column reduces the likelihood of a fish encountering high concentrations of TNT to near zero.

There are no training or testing activities involving ingestible expended materials proposed for the Western Behm Canal portion of the Study Area under any alternative. Therefore, there would be no impact from ingestible expended materials in the Western Behm Canal portion of the Study Area from any alternative.

3.9.3.5.1.1 No Action Alternative

Training Activities

Offshore Area

Projectiles

Table 3.0-20 lists the number and location of small- and medium-caliber projectiles. As indicated in Section 3.0.5.3.5.1 (Non-explosive Practice Munitions) under the No Action Alternative, small- and medium-caliber projectile use would occur in the Offshore Area. Species that occur in these areas would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-21 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-4; however, the fragment size cannot be quantified. As indicated in Section 3.0.5.3.5.2 (Fragments from High-Explosive Munitions) under the No Action Alternative, high-explosive ordnance and munitions use would occur in the offshore OPAREA. Species that occur in these areas would have the potential to be exposed to fragments from high explosive ordnance and munitions. These items are heavy and would sink immediately to the seafloor, so exposure to fishes would be limited to those groups identified as

bottom-dwelling predators and scavengers. It is possible that expended small-caliber projectiles on the seafloor could be colonized by seafloor organisms and mistaken for prey or that expended small-caliber projectiles could be accidentally or intentionally eaten during foraging. Over time, the metal corrodes slowly or may become covered by sediment in some habitats, reducing the likelihood of a fish encountering the small-caliber non explosive practice munitions. High explosive munitions are typically fused to detonate within 5 ft. (1.5 m) of the water surface, with steel fragments breaking off in all directions and rapidly decelerating in the water and settling to the seafloor. The analysis generally assumes that most explosive expended materials sink to the seafloor and become incorporated into the seafloor with no substantial accumulations in any particular area (see Section 3.1, Sediments and Water Quality).

Encounter rates in locations with concentrated small-caliber projectiles would be assumed to be greater than in less concentrated areas. Fishes feeding on the seafloor in the offshore locations where these items are expended (e.g., focused in gunnery boxes) would be more likely to encounter these items and at risk for potential ingestion impacts than in other locations. If ingested, these items could potentially disrupt an individual's feeding behavior or digestive processes. If the item is particularly large for the fish ingesting it, the projectile could become permanently encapsulated by the stomach lining, with the rare chance that this could impede the fish's ability to feed or take in nutrients (Danner et al. 2009; Hoss and Settle 1990). However, in most cases a fish would pass the round and smooth item through their digestive tract and expel the item with full recovery expected without impacting the individual's growth, survival, annual reproductive success, or lifetime reproductive success.

Unexploded high-explosive munitions would sink to the bottom. The residual explosive material would not be exposed to the marine environment for a long time, possibly many years, as it is encased in a non-buoyant cylindrical package. When the HMX or RDX are eventually exposed on the ocean floor, they would break down within a few hours (U.S. Department of the Navy 2001b) and would not accumulate in the tissues of fishes (Lotufo et al. 2010; Price et al. 1998). TNT would bioaccumulate in fish tissues if present at high concentrations in the water, but not from fish exposure to TNT in sediments (Lotufo et al. 2010). Given the rapid dispersal and dilution expected in the marine water column, the likelihood of a fish encountering high concentrations of TNT is very low. Over time, RDX residue would be covered by ocean sediments in most habitats or diluted by ocean water.

It is not possible to predict the size or shape of fragments resulting from high explosives. High explosives used in the Study Area range in size from medium-caliber projectiles to large bombs, rockets, and missiles. When these items explode, they partially break apart or remain largely intact with irregular shaped pieces—some of which may be small enough for a fish to ingest. Fishes would not be expected to ingest most fragments from high explosives because most pieces would be too large to ingest. Also, since fragment size cannot be quantified, it is assumed that fragments from larger munitions are similarly sized as larger munitions, but more fragments would result from larger munitions than smaller munitions. Small-caliber projectiles far outnumber the larger-caliber high explosive projectiles/bombs/missiles/rockets expended as fragments in the Study Area. Although it is possible that the number of fragments resulting from a high explosive could exceed this number, this cannot be quantified. Therefore, small-caliber projectiles would be more prevalent throughout the Study Area and more likely to be encountered by bottom-dwelling fishes and potentially ingested than fragments from any type of high explosive munitions.

Chaff and Flares

Tables 3.0-27 and 3.0-28 lists the number and location of expended chaff and flares in the Offshore Area. As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions) under the No Action Alternative, activities that expend chaff and flares occur in the open ocean areas of the Study Area. Species that occur in these areas would have the potential to be exposed to chaff and flares. Under the No Action Alternative, a total of 160 chaff cartridges would be expended from aircraft during training activities. No potential impacts would occur from the chaff itself, as discussed in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), but there is some potential for the end caps or pistons associated with the chaff cartridges to be ingested. Under the No Action Alternative, a total of 184 flares would be expended during training flare exercises. The flare device consists of a cylindrical cartridge approximately 1.4 in (3.6 cm) in diameter and 5.8 in (14.7 cm) in length. Items that could be potentially ingested from flares include plastic end caps and pistons. An extensive literature review and controlled experiments conducted by the U.S. Air Force revealed that self-protection flare use poses little risk to the environment (U.S. Air Force 1997). The light generated by flares in the air (designed to burn out completely prior to entering the water) would have no impact on fish based on short burn time, relatively high altitudes where they are used, and their wide-spread and infrequent use. The potential exists for large, open-ocean predators (e.g., tunas, billfishes, pelagic sharks) to ingest self-protection flare end caps or pistons as they float on the water column for some time. A variety of plastic and other solid materials have been recovered from the stomachs of billfishes, dorado (South Atlantic Fishery Management Council 2011) and tuna (Hoss and Settle 1990).

End caps and pistons eventually sink in salt water (Spargo 1999), which reduces the likelihood of ingestion by surface-feeding fishes. However, some of the material could remain at or near the surface, and predatory fishes may incidentally ingest these items.

Based on the low environmental concentration (Tables 3.3-4 through 3.3-7), it is unlikely that a large number of fish would ingest an end cap or piston, much less a harmful quantity. Furthermore, a fish might expel the item before swallowing it. The number of fish potentially impacted by ingestion of end caps or pistons would be low based on the low environmental concentration and population-level impacts are not expected to occur.

Summary of Training Activities

Overall, the potential impacts of ingesting small-caliber projectiles, high explosive fragments, decelerator/parachutes, or end caps/pistons would be limited to individual cases where a fish might suffer a negative response, for example, by ingesting an item too large to be digested. While ingestion of ordnance-related materials or the other military expended materials identified here could result in sublethal or lethal impacts, the likelihood of ingestion is low based on the dispersed nature of the materials and the limited exposure of those items at the surface/water column or seafloor where certain fishes could be at risk of ingesting those items. Furthermore, a fish might taste an item then expel it before swallowing it (Felix et al. 1995) in the same manner that fish would temporarily take a lure into its mouth, then spit it out. Based on these factors, the number of fish potentially impacted by ingestion of ordnance-related materials would be low and population-level impacts are not likely to occur.

While ingestible expended materials could overlap with all of the ESA-listed species, the likelihood of ingestment would be extremely low given the low abundance of ESA-listed species in the Study Area, and the dispersed nature of the activity. However, there would be the potential for effect. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and

estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, ingestible expended materials would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the ingestible expended materials in the Offshore Area; however, any effects would be to prey species and would be minimal.

Inland Waters

Projectiles

Table 3.0-20 lists the number and location of small- and medium-caliber projectiles. As indicated in Section 3.0.5.3.5.1 (Non-Explosive Practice Munitions), under the No Action Alternative, small- and medium-caliber projectile use would not occur in the Inland Waters.

Table 3.0-21 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-4; however, the fragment size cannot be quantified. As indicated in Section 3.0.5.3.5.2 (Fragments from High-Explosive Munitions), under the No Action Alternative, only four underwater detonation high explosives that may result in fragments would occur in the Inland Waters section of the Study Area. Species that occur in these areas would have the potential to be exposed to fragments from high explosive ordnance and munitions. These items are heavy and would sink immediately to the seafloor, so exposure to fishes would be limited to those groups identified as bottom-dwelling predators and scavengers. High explosive munitions are typically fused to detonate within 5 ft. (1.5 m) of the water surface, with steel fragments breaking off in all directions and rapidly decelerating in the water and settling to the seafloor. The analysis generally assumes that most explosive expended materials sink to the seafloor and become incorporated into the seafloor, with no substantial accumulations in any particular area (see Section 3.1, Sediments and Water Quality).

If ingested, these items could potentially disrupt an individual's feeding behavior or digestive processes. If the item is particularly large for the fish ingesting it, the projectile could become permanently encapsulated by the stomach lining, with the rare chance that this could impede the fish's ability to feed or take in nutrients (Danner et al. 2009; Hoss and Settle 1990). However, in most cases a fish would pass the round and smooth item through their digestive tract and expel the item with full recovery expected without impacting the individual's growth, survival, annual reproductive success, or lifetime reproductive success.

Unexploded high-explosive munitions would sink to the bottom. The residual explosive material would not immediately be exposed to the marine environment as it is encased in a non-buoyant cylindrical package that may take years to slowly decay. When the HMX or RDE are eventually exposed on the ocean floor, they would break down within a few hours (U.S. Department of the Navy 2001b) and would not accumulate in the tissues of fishes (Lotufo et al. 2010; Price et al. 1998). TNT would bioaccumulate in fish tissues if present at high concentrations in the water, but not from fish exposure to TNT in sediments (Lotufo et al. 2010). Given the rapid dispersal and dilution expected in the marine water column, the likelihood of a fish encountering high concentrations of TNT is very low. Over time, RDX residue would be covered by ocean sediments in most habitats or diluted by ocean water (Section 3.1, Sediments and Water Quality, Section 3.1.3.1, Explosives and Explosion Byproducts).

It is not possible to predict the size or shape of fragments resulting from high explosives. High explosives used in Inland Waters are underwater explosives. When these items explode, they partially break apart or remain largely intact with irregular shaped pieces—some of which may be small enough for a fish to

ingest. Fishes would not be expected to ingest most fragments from high explosives because most pieces would be too large to ingest. Also, since fragment size cannot be quantified, it is assumed that fragments from larger munitions are similarly sized as larger munitions, but more fragments would result from larger munitions than smaller munitions.

Chaff and Flares

Under the No Action Alternative, activities that expend chaff and flares do not occur in the Inland Waters portion of the Study Area.

Summary of Training Activities

Overall, the potential impacts of ingesting underwater detonations or their fragments would be limited to individual cases where a fish might suffer a negative response, for example, ingesting an item too large to be digested. While ingestion of ordnance-related materials, or the other military expended materials identified here, could result in sublethal or lethal impacts, the likelihood of ingestion is low based on the dispersed nature of the materials, the low number dispersed, and the limited exposure of those items at the surface/water column or seafloor where certain fishes could be at risk of ingesting those items. Furthermore, a fish might taste an item then expel it before swallowing it (Felix et al. 1995), in the same manner that fish would temporarily take a lure into its mouth, then spit it out. Based on these factors, the number of fish potentially impacted by ingestion of ordnance-related materials would be low and population-level impacts are not likely to occur.

Based on the primarily nearshore distribution of all ESA-listed species and areas of munitions use, potential ingestion would be extremely low given the unlikelihood for ESA-listed species to occur in the areas of munitions use and the dispersed nature of the activity. The majority of the PCEs required by coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, munitions use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon critical habitat. There could be an effect on the nearshore critical habitat for Chinook and chum salmon; however, any effects would be to prey species and would be minimal.

Pursuant to the ESA, ingestion stressors occurring for training activities under the No Action Alternative may affect, but are not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Ingestion stressors associated with training activities under No Action Alternative may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

Testing Activities

Offshore Area

Under the No Action Alternative, a variety of potentially ingestible military expended materials would be released to the Offshore Area of the Study Area during Navy testing activities. No chaff canisters would be released during testing activities under the No Action Alternative. Ingestion of military expended materials such as sonobuoys, in-water devices, and guidance wires are not likely as they are too large to be ingested by most fish. The total number of military expended munitions expended under the No Action Alternative in the Offshore Area is 200, and the number of military expended materials other than munitions expended in the Offshore Area is 421 (Table 3.9-4).

While ingestible expended materials could overlap with all of the ESA-listed species, the likelihood of ingestment would be extremely low given the low abundance of ESA-listed species in the Study Area, and the dispersed nature of the activity. However, there would be the potential for effect. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, ingestible expended materials would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the ingestible expended materials in the Offshore Area; however, any effects would be to prey species and would be minimal.

Inland Waters

Under the No Action Alternative, no testing activities use small- or medium-caliber projectiles (Table 3.0-20). Testing of torpedo projectiles and sonobuoys would occur in the Inland Waters under the No Action Alternative. Under the No Action Alternative, no testing activities would expend fragments from high-explosive ordnance and munitions (Table 3.0-21). Under the No Action Alternative, no testing activities use chaff or flares (Tables 3.0-27 and 3.0-28).

Overall, the potential impacts of ingesting fragments from explosive torpedoes and sonobuoys would be limited to individual cases where a fish might suffer a negative response, for example, ingesting an item too large to be digested. The likelihood of ingestion is low based on the dispersed nature of the materials, the low number dispersed, and the limited exposure of those items at the surface/water column or seafloor where certain fishes could be at risk of ingesting those items. Furthermore, a fish might taste an item then expel it before swallowing it (Felix et al. 1995) in the same manner that fish would temporarily take a lure into its mouth, then spit it out. Based on these factors, the number of fish potentially impacted by ingestion of ordnance-related materials would be low and population-level impacts are not likely to occur.

Based on the primarily nearshore distribution of all ESA-listed species and areas of munitions use, potential ingestion would be extremely low given the unlikelihood for ESA-listed species to occur in the areas of munitions use and the dispersed nature of the activity. The majority of the PCEs required by coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, munitions use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon critical habitat. There could be an effect on the nearshore critical habitat for Chinook and Chum salmon; however, any effects would be to prey species and would be minimal.

Pursuant to the ESA, ingestion of munitions or military expended material under the No Action Alternative may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Ingestion of munitions or military expended material for testing activities under the No Action Alternative may affect, but is not likely to adversely affect, nearshore critical habitat for green sturgeon, Chinook, and chum salmon; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

3.9.3.5.1.2 Alternative 1

Training Activities

Offshore Area

Projectiles

Table 3.0-20 lists the number and location of small- and medium- caliber projectiles. The number and location of small- and medium- caliber projectiles does not change from the No Action Alternative under Alternative 1. As indicated in Section 3.0.5.3.5.1 (Non-Explosive Practice Munitions), under Alternative 1, small- and medium-caliber projectile use would occur in the offshore area, open ocean portions of the Study Area. Species that occur in these areas would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-21 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-5; however, the fragment size cannot be quantified. As indicated in Section 3.0.5.3.5.2 (Fragments from High-Explosive Munitions), under Alternative 1, high-explosive ordnance and munitions use would occur in the Offshore Area, open ocean portions of the Study Area. Species that occur in these areas would have the potential to be exposed to fragments from high explosive ordnance and munitions.

Chaff and Flares

Tables 3.0-27 and 3.0-28 lists the number and location of expended chaff and flares. As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions) under Alternative 1, activities that expend chaff and flares occur in the Offshore Area, open ocean portion of the Study Area. Species that occur in these areas would have the potential to be exposed to chaff and flares.

The use of Chaff increases from 2,900 under the No Action Alternative, to 5,000 under Alternative 1. This increase in expended materials would increase the probability of ingestion risk; however, as discussed under the No Action Alternative, the likelihood of ingestion would still be low based on the dispersed nature of the materials and the limited exposure of those items at the surface/water column or seafloor where certain fishes could be at risk of ingesting those items. Therefore, the number of fish potentially impacted by ingestion of expended materials would be low and population-level impacts are not likely to occur.

While ingestible expended materials could overlap with all of the ESA-listed species, the likelihood of ingestment would be extremely low given the low abundance of ESA-listed species in the Study Area, and the dispersed nature of the activity. However, there would be the potential for effect. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, ingestible expended materials would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the ingestible expended materials in the Offshore Area; however, any effects would be to prey species and would be minimal.

Inland Waters

Projectiles

Table 3.0-20 lists the number and location of projectiles expended under Alternative 1. As indicated in Section 3.0.5.3.5.1 (Non-Explosive Practice Munitions) under Alternative 1, small- and medium-caliber projectile use would not occur in the Inland Waters portions of the Study Area.

Table 3.0-21 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-5; however, the fragment size cannot be quantified. As indicated in Section 3.0.5.3.5.2 (Fragments from High-Explosive Munitions), under Alternative 1, underwater detonations would increase from 4 in the No Action Alternative to 42 under Alternative 1. Species that occur in these areas would have the potential to be exposed to fragments from high explosive ordnance and munitions.

Chaff and Flares

Under Alternative 1, no training activities use chaff or flares in the Inland Waters (Tables 3.0-27 and 3.0-28).

Based on the primarily nearshore distribution of all ESA-listed species and areas of munitions use, potential ingestion would be extremely low given the unlikelihood of ESA-listed species to occur in the areas of munitions use and the dispersed nature of the activity. The majority of the PCEs required by coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, munitions use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon critical habitat. There could be an effect on the nearshore critical habitat for Chinook and Chum salmon; however, any effects would be to prey species and would be minimal.

Pursuant to the ESA, ingestion stressors occurring under Alternative 1 may affect, but are not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

Ingestion stressors associated with training activities under Alternative 1 may affect, but are not likely to adversely affect, critical habitat for Chinook, chum, and green sturgeon; and would have no effect on critical habitat for coho, steelhead, bull trout, sockeye, or Pacific eulachon.

Testing Activities

Offshore Area

Under Alternative 1, no testing activities use small- or medium-caliber projectiles (Table 3.0-20). Under Alternative 1, no testing activities would expend fragments from high-explosive ordnance and munitions (Table 3.0-21). Under Alternative 1, no testing activities use chaff or flares (Tables 3.0-27 and 3.0-28). Based on the lack of expended materials used in testing activities under Alternative 1, there would be no effect to ESA-listed species or their associated critical habitats.

Inland Waters

Under Alternative 1, no testing activities would use small- or medium-caliber projectiles in the Inland Waters (Table 3.0-20). Under Alternative 1, no testing activities would expend fragments from high-explosive ordnance and munitions (Table 3.0-21). Under Alternative 1, no testing activities would use flares in the Inland Waters (Tables 3.0-27 and 3.0-28).

Based on the primarily nearshore distribution of all ESA-listed species and areas of munitions use, potential ingestion would be extremely low given the unlikelihood for ESA-listed species to occur in the areas of flares use and the dispersed nature of the activity. The majority of the PCEs required by coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, munitions use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon critical habitat. There could be an effect on the nearshore critical habitat for Chinook and Chum salmon; however, any effects would be to prey species and would be minimal.

Pursuant to the ESA, ingestion of munitions or military expended material other than munitions for testing activities under Alternative 1 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

Ingestion of munitions or military expended material other than munitions for testing activities under Alternative 1 may affect, but is not likely to adversely affect, nearshore critical habitat for Chinook and chum salmon; and would have no effect on critical habitat for Pacific eulachon, green sturgeon, coho, steelhead, bull trout, and sockeye.

3.9.3.5.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the number of military expended materials would be the same as under Alternative 1 (Table 3.9-4). Therefore, the impact of military expended materials would be the same as under Alternative 1.

While ingestible expended materials could overlap with all of the ESA-listed species, the likelihood of ingestment would be extremely low given the low abundance of ESA-listed species in the Study Area, and the dispersed nature of the activity. However, there would be the potential for effect. The majority of the PCEs required by the salmonid species and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Offshore Area. Therefore, ingestible expended materials would have no effect on salmonid species and Pacific eulachon critical habitat. Green sturgeon critical habitat may be affected by the ingestible expended materials in the Offshore Area; however, any effects would be to prey species and would be minimal.

Inland Waters

Under Alternative 2, the Navy proposes the same numbers and types of military expended materials as described in Alternative 1. Therefore, the impacts of Alternative 2 training activities on fish would be the same as for Alternative 1.

Based on the primarily nearshore distribution of all ESA-listed species and areas of munitions use, potential ingestion would be extremely low given the unlikelihood for ESA-listed species to occur in the areas of flares use and the dispersed nature of the activity. The majority of the PCEs required by coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, munitions use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon critical habitat. There could be an effect on the nearshore critical habitat for Chinook and Chum salmon; however, any effects would be to prey species and would be minimal.

Pursuant to the ESA, ingestion stressors occurring in the Offshore Area under Alternative 2 may affect, but are not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Ingestion stressors associated with training activities under Alternative 2 may affect, but are not likely to adversely affect, green sturgeon, Chinook, and chum salmon critical habitat; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

Testing Activities

Offshore Area

Under Alternative 2, no testing activities use small- or medium-caliber projectiles (Table 3.0-20). Under Alternative 2, no testing activities would expend fragments from high-explosive ordnance and munitions (Table 3.0-21). Under Alternative 2, no testing activities use chaff or flares (Tables 3.0-27 and 3.0-28). Based on the lack of expended materials used in testing activities under Alternative 2, there would be no effect to ESA-listed species or their associated critical habitats.

Inland Waters

Under Alternative 2, the number of military expended materials would only increase by approximately 5 percent compared to Alternative 1 (Table 3.9-4). Therefore, the impacts of military expended materials would be similar to those discussed under Alternative 1.

Based on the primarily nearshore distribution of all ESA-listed species and areas of munitions use, potential ingestion would be extremely low given the unlikelihood for ESA-listed species to occur in the areas of flares use and the dispersed nature of the activity. The majority of the PCEs required by coho, steelhead, bull trout, sockeye, green sturgeon, and Pacific eulachon are applicable to fresh water and estuaries (i.e., spawning sites, rearing sites, and migration corridors) and are outside the Study Area. Therefore, munitions use would have no effect on coho, steelhead, bull trout, sockeye, green sturgeon and Pacific eulachon critical habitat. There could be an effect on the nearshore critical habitat for Chinook and Chum salmon; however, any effects would be to prey species and would be minimal.

Pursuant to the ESA, ingestion of munitions or military expended material other than munitions for testing activities under Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

Ingestion of munitions or military expended material other than munitions for testing activities under Alternative 2 may affect, but is not likely to adversely affect, nearshore critical habitat for Chinook and chum salmon; and would have no effect on critical habitat for Pacific eulachon, green sturgeon, coho, steelhead, bull trout, and sockeye.

3.9.3.5.1.4 Combined Ingestion Stressors

An individual fish could experience the following consequences of ingestion stressors: stress, behavioral changes, ingestion causing injury, and ingestion causing mortality. Ingestion causing mortality cannot act in combination because mortal injuries occur with the first instance. Therefore, there is no possibility for the occurrence of this consequence to increase if sub-stressors are combined.

Sub-lethal consequences may result in delayed mortality because they cause irrecoverable injury or alter the individual's ability to feed or detect and avoid predation. Normally, for fish large enough to ingest it, most small-caliber projectiles would pass through a fish’s digestive system without injury. However, in

this scenario it is possible that a fish's digestive system could already be compromised or blocked in such a manner that the small-caliber projectiles can no longer easily pass through without harm. It is conceivable that a fish could first ingest a small bomb fragment that might damage or block its digestive tract, then ingest a small-caliber projectile, with magnified combined impacts. Sub-lethal effects resulting in mortality could be more likely if the activities occurred in essentially the same location and occurred within the individual's recovery time from the first disturbance. This circumstance is likely to arise only during training and testing activities that cause frequent and recurring ingestion stressors to essentially the same location (e.g., chaff cartridge end caps/flares expended at the same location as small-caliber projectiles). In these specific circumstances the potential consequences to fishes from combinations of ingestion stressors may be greater than the sum of their individual consequences.

These specific circumstances that could magnify the consequences of ingestion stressors are highly unlikely to occur because, with the exception of a SINKEX, it is highly unlikely that chaff cartridge end caps/flares and small-caliber projectiles would impact essentially the same location because most of these sub-stressors are widely dispersed in time and space.

The combined impact of these sub-stressors does not increase the risk in a meaningful way because the risk of injury or mortality is extremely low for each sub-stressor independently. While it is conceivable that interaction between sub-stressors could magnify their combined risks, the necessary circumstances are highly unlikely to overlap. Interaction between ingestion sub-stressors is likely to have neutral consequences for fishes.

Pursuant to the ESA, the use of munitions or military expended materials of ingestible size for training activities under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, Pacific eulachon, green sturgeon, and rockfish species.

The use of munitions or military expended materials of ingestible size for training activities under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but is not likely to adversely affect, nearshore critical habitat for green sturgeon, Chinook, and chum salmon; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

3.9.3.5.1.5 Summary and Conclusions of Ingestion Impacts

The Navy identified and analyzed three military expended materials types that have ingestion potential for fishes: non-explosive practice munitions, military expended materials from high explosives, and military expended materials from non-ordnance items (e.g., end caps, canisters, chaff, and accessory materials). The probability of fishes ingesting military expended materials depends on factors such as the size, location, composition, and the buoyancy of the expended material. These factors, combined with the location and feeding behavior of fishes were used to analyze the likelihood the expended material would be mistaken for prey and what the potential impacts would be if ingested. Most expended materials, such as large- and medium-caliber ordnance, would be too large to be ingested by a fish, but other materials, such as small-caliber munitions or some fragments of larger items, may be small enough to be swallowed by some fishes. During normal feeding behavior, many fishes ingest nonfood items and often reject (spit out) nonfood items prior to swallowing. Other fishes may ingest and swallow both food and nonfood items indiscriminately. There are concentrated areas where bombing, missile, and gunnery activities that generate materials that could be ingested. However, even within those areas, the overall impact on fishes would be inconsequential.

The potential impacts of military expended material ingestion would be limited to individual cases where a fish might suffer a negative response, for example, ingesting an item too large, sharp, or pointed to pass through the digestive tract without causing damage. Based on available information, it is not possible to accurately estimate actual ingestion rates or responses of individual fishes. Nonetheless, the number of military expended materials ingested by fishes is expected to be very low and only an extremely small percentage of the total would be potentially encountered by fishes. Certain feeding behavior such as “suction feeding” along the seafloor exhibited by sturgeon may increase the probability of ingesting military expended materials relative to other fishes; however, encounter rates would still remain low.

3.9.3.6 Secondary Stressors

This section analyzes potential impacts on fishes exposed to stressors indirectly through impacts on habitat, sediment, or water quality. These are also primary elements of marine fish habitat and firm distinctions between indirect impacts and habitat impacts are difficult to maintain. For the purposes of this analysis, indirect impacts on fishes via sediment or water which do not require trophic transfer (e.g., bioaccumulation) in order to be observed are considered here. It is important to note that the terms "indirect" and "secondary" do not imply reduced severity of environmental consequences, but instead describe how the impact may occur in an organism or its ecosystem.

Stressors from Navy training and testing activities could pose secondary or indirect impacts on fishes via habitat, sediment, and water quality. These include (1) explosives and by-products; (2) metals; (3) chemicals; (4) other materials such as targets, chaff, and plastics, and (5) impacts on fish habitat. Activities associated with these stressors are detailed in Tables 2.8-1 through 2.8-3, and analyses of their potential impacts are discussed in Section 3.1 (Sediments and Water Quality) and Section 3.3 (Marine Habitats).

3.9.3.6.1 Explosives

In addition to directly impacting fish and fish habitat, underwater explosions could impact other species in the food web including plankton and other prey species that fish feed upon. The impacts of underwater explosions would differ depending upon the type of prey species in the area of the blast. As discussed in Section 3.9.3.1 (Acoustic Stressors), fish with swim bladders are more susceptible to blast injuries than fish without swim bladders.

In addition to physical impacts of an underwater blast, prey might have behavioral reactions to underwater sound. For instance, prey species might exhibit a strong startle reaction to detonations that might include swimming to the surface or scattering away from the source. This startle and flight response is the most common secondary defense among animals (Hanlon and Messenger 1996). The sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity. The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. Alternatively, any prey species that would be directly injured or killed by the blast could draw in scavengers from the surrounding waters that would feed on those organisms, and in turn could be susceptible to becoming directly injured or killed by subsequent explosions. Any of these scenarios would be temporary, only occurring during activities involving explosives, and no lasting impact on prey availability or the pelagic food web would be expected. Indirect impacts of underwater detonations and high explosive ordnance use under the Proposed Action would not result in a decrease in the quantity or quality of fish populations or fish habitats in the Study Area.

3.9.3.6.2 Explosion By-Products, and Unexploded Ordnance

Deposition of undetonated explosive materials into the marine environment can be reasonably well estimated by the known failure and low-order detonation rates of high explosives. Undetonated explosives associated with mine neutralization activities are collected after training is complete; therefore, potential impacts are assumed to be inconsequential for these training and testing activities, but other activities could result in unexploded ordnance and unconsumed explosives on the seafloor. Fishes may be exposed by contact with the explosive, contact with contaminants in the sediment or water, and ingestion of contaminated sediments.

High-order explosions consume most of the explosive material, creating typical combustion products. In the case of RDX, 98 percent of the products are common seawater constituents and the remainder are rapidly diluted below threshold impact level. Explosion by-products associated with high order detonations present no indirect stressors to fishes through sediment or water. However, low order detonations and unexploded ordnance present elevated likelihood of impacts on fishes.

Indirect impacts of explosives and unexploded ordnance to fishes via sediment is possible in the immediate vicinity of the ordnance. Degradation of explosives proceeds via several pathways discussed in Section 3.1 (Sediments and Water Quality). Degradation products of RDX are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo 2010). TNT and its degradation products impact developmental processes in fishes and are acutely toxic to adults at concentrations similar to real-world exposures (Halpern et al. 2008; Rosen and Lotufo 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6–12 in (15.2–30.5 cm) away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3–6 ft. (0.9–1.8 m) from the degrading ordnance (see Section 3.1, Sediments and Water Quality). Taken together, it is likely that various lifestages of fishes could be impacted by the indirect impacts of degrading explosives within a very small radius of the explosive 1–6 ft. (0.3–1.8 m).

3.9.3.6.3 Metals

Certain metals are harmful to fishes at concentrations above background levels (e.g., cadmium, chromium, lead, mercury, zinc, copper, manganese, and many others) (Wang and Rainbow 2008). Metals are introduced into seawater and sediments as a result of Navy training and testing activities involving vessel hulks, targets, ordnance, munitions, and other military expended materials (see Section 3.1.3.2, Metals). Some metals bioaccumulate and physiological impacts begin to occur only after bioaccumulation concentrates the metals (see Section 3.3, Marine Habitats, and Chapter 4, Cumulative Impacts). Indirect impacts of metals to fishes via sediment and water involve concentrations several orders of magnitude lower than concentrations achieved via bioaccumulation. Fishes may be exposed by contact with the metal, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Concentrations of metals in sea water are orders of magnitude lower than concentrations in marine sediments. It is extremely unlikely that fishes would be indirectly impacted by toxic metals via the water.

3.9.3.6.4 Chemicals

Several Navy training and testing activities introduce potentially harmful chemicals into the marine environment; principally, flares and propellants for rockets, missiles, and torpedoes. Polychlorinated biphenyls (PCBs) are discussed in Section 3.1 (Sediments and Water Quality). Properly functioning flares

missiles, rockets, and torpedoes combust most of their propellants, leaving only benign or readily diluted soluble combustion by-products (e.g., hydrogen cyanide). Operational failures allow propellants and their degradation products to be released into the marine environment.

The greatest risk to fishes from flares, missile, and rocket propellants is perchlorate, which is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals. Fishes may be exposed by contact with contaminated water or ingestion of contaminated sediments. Since perchlorate is highly soluble, it does not readily absorb to sediments. Therefore, missile and rocket fuel poses no risk of indirect impact on fishes via sediment. In contrast, the principal toxic components of torpedo fuel, propylene glycol dinitrate and nitrodiphenylamine, adsorb to sediments, have relatively low toxicity, and are readily degraded by biological processes (see Section 3.1, Sediments and Water Quality). It is conceivable that various lifestages of fishes could be indirectly impacted by propellants via sediment in the immediate vicinity of the object (e.g., within a few inches [a few cm]), but these potential impacts would diminish rapidly as the propellant degrades.

3.9.3.6.5 Other Materials

Some military expended materials (e.g., decelerator/parachutes) could become remobilized after their initial contact with the seafloor (e.g., by waves or currents) and could be reintroduced as an entanglement or ingestion hazards for fishes. In some bottom types (without strong currents, hard-packed sediments, and low biological productivity), items such as projectiles might remain intact for some time before becoming degraded or broken down by natural processes. While these items remain intact sitting on the bottom, they could potentially remain ingestion hazards. These potential impacts may cease only (1) when the military expended materials are too massive to be mobilized by typical oceanographic processes, (2) if the military expended materials become encrusted by natural processes and incorporated into the seafloor, or (3) when the military expended materials become permanently buried. In this scenario, a decelerator/parachute could initially sink to the seafloor, but then be transported laterally through the water column or along the seafloor, increasing the opportunity for entanglement. In the unlikely event that a fish would become entangled, injury or mortality could result. However, the entanglement stressor would eventually cease to pose an entanglement risk as the item becomes encrusted or buried.

3.9.3.6.6 Impacts on Fish Habitat

The Proposed Action could result in localized and temporary changes to the benthic community during activities that impact fish habitat. Fish habitat could become degraded during activities that would strike the seafloor or introduce military expended materials, bombs, projectiles, missiles, rockets, or fragments to the seafloor. During, or following activities that impact benthic habitats, fish species may experience loss of available benthic prey at locations in the Study Area where these items might be expended on essential fish habitat or habitat areas of particular concern. Additionally, plankton and zooplankton that are eaten by fish may also be negatively impacted by these same expended materials. The spatial area of essential fish habitat and habitat areas of particular concern impacted by the Proposed Action would be relatively small compared to the available habitat in the Study Area. However, there would still be vast expanses of essential fish habitat and habitat areas of particular concern adjacent to the areas of habitat impact that would remain undisturbed by the Proposed Action.

Impacts of physical disturbance and strikes by small, medium, and large projectiles would be concentrated within designated gunnery box areas, resulting in localized disturbances of hard bottom areas, but could occur anywhere in the Study Area. Hard bottom is important habitat for many different species of fish, including those fishes managed by various fishery management plans.

When a projectile hits a biogenic habitat (a habitat that is produced by other living organisms), the substrate immediately below the projectile is not available at that habitat type on a long-term basis, until the material corrodes. The substrate surrounding the projectile would be disturbed, possibly resulting in short-term localized increased turbidity. Given the large spatial area of the range complexes compared to the small percentage covered by biogenic habitat, it is unlikely that most of the small, medium, and large projectiles expended in the Study Area would fall onto this habitat type. Furthermore, these activities are distributed within discrete locations within the Study Area, and the overall footprint of these areas is quite small with respect to the spatial extent of this biogenic habitat within the Study Area.

Sinking exercises could also provide secondary impacts on deep sea populations. These activities occur in open-ocean areas, outside of the coastal range complexes, with potential direct disturbance or strike impacts on deep sea fishes. Secondary impacts on these fishes could occur after the ship hulks sink to the seafloor. Over time, the ship hulk would be colonized by marine organisms that attach to hard surfaces. For fishes that feed on these types of organisms, or whose abundances are limited by available hard structural habitat, the ships that are sunk during SINKEX could provide an incidental beneficial impact on the fish community (Love and York 2006).

Designated critical habitat of the ESA-listed coho, steelhead, bull trout, sockeye, and Pacific eulachon includes estuarine and freshwater habitat and is outside the Study Area. Therefore, there would be no impacts associated with secondary stressors. However, critical habitat for Chinook, chum, and green sturgeon is within the Study Area and there would be minimal impacts associated with secondary stressors, including water column effects, disturbed sediments, and prey availability.

Pursuant to the ESA, secondary stressors may affect, but is not likely to adversely affect ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

Secondary stressors may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

3.9.4 Summary of Potential Impacts on Fish

3.9.4.1 Combined Impacts of All Stressors

As described in Section 3.0.5.5 (Resource-Specific Impacts Analysis for Multiple Stressors), this section evaluates the potential for combined impacts of all the stressors from the Proposed Action. The analysis and conclusions for the potential impacts from each individual stressor are discussed in the analyses of each stressor in the sections above and summarized in Section 3.9.4.2 (Endangered Species Act Determinations).

There are generally two ways that a fish could be exposed to multiple stressors. The first would be if a fish were exposed to multiple sources of stress from a single activity (e.g., a mine warfare activity may include the use of a sound source and a vessel). The potential for a combination of these impacts from a single activity would depend on the range of effects of each stressor and the response or lack of response to that stressor. Most of the activities described in the Proposed Action involve multiple stressors; therefore, it is likely that if a fish were within the potential impact range of those activities, they may be impacted by multiple stressors simultaneously. This would be even more likely to occur

during large-scale exercises or activities that span a period of days or weeks (such as a SINKEX or composite training unit exercise).

A fish could be exposed to a combination of stressors from multiple activities over the course of its life. This is most likely to occur in areas where training and testing activities are more concentrated (e.g., near naval ports, testing ranges, and routine activity locations and in areas that individual fish frequent because it is within the animal's home range, migratory corridor, spawning or feeding area). Except for in the few concentration areas mentioned above, combinations are unlikely to occur because training and testing activities are generally separated in space and time in such a way that it would be very unlikely that any individual fish would be exposed to stressors from multiple activities. However, animals with a home range intersecting an area of concentrated Navy activity have elevated exposure risks relative to animals that simply transit the area through a migratory corridor. The majority of the proposed training and testing activities occur over a small spatial scale relative to the entire Study Area, have few participants, and are of a short duration (a few hours or less).

Multiple stressors may also have synergistic effects. For example, fish that experience temporary hearing loss or injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. Fish that experience behavioral and physiological consequences of ingestion stressors could be more susceptible to entanglement and physical strike stressors via malnourishment and disorientation. These interactions are speculative, and without data on the combination of multiple Navy stressors, the synergistic impacts from the combination of Navy stressors are difficult to predict in any meaningful way. Navy research and monitoring efforts include data collection through conducting long-term studies in areas of Navy activity, occurrence surveys over large geographic areas, biopsy of animals occurring in areas of Navy activity, and tagging studies where animals are exposed to Navy stressors. These efforts are intended to contribute to the overall understanding of what impacts may be occurring overall to animals in these areas.

Although potential impacts to certain fish species from the Proposed Action may include injury or mortality, impacts are not expected to decrease the overall fitness of any given population. Mitigation measures designed to reduce the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). The potential impacts anticipated from the Proposed Action are summarized in Section 3.9.4.2 (Endangered Species Act Determinations), with respect to each regulation applicable to fish.

Pursuant to the ESA, the combined impacts of all the stressors under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but is not likely to adversely affect, ESA-listed salmonid species, green sturgeon, Pacific eulachon, and rockfish species.

The combined impacts of all the stressors under the No Action Alternative, Alternative 1, or Alternative 2 may affect, but are not likely to adversely affect, critical habitat for green sturgeon, Chinook, and chum; and would have no effect on critical habitat for Pacific eulachon, coho, steelhead, bull trout, and sockeye.

3.9.4.2 Endangered Species Act Determinations

Table 3.9-7 summarizes the ESA determinations for each sub-stressor analyzed.

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for the Preferred Alternative (Alternative 1)

Stressor		Salmonid Species	Salmonid Critical Habitat	Pacific Eulachon	Pacific Eulachon Critical Habitat	Green Sturgeon	Green Sturgeon Critical Habitat	Rockfish Species
Acoustic Stressors								
Sonar and other non-implusive sources	Training	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
Explosives and other non-impulse sources	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Energy Stressors								
Electromagnetic devices	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
	Testing	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Physical Disturbance and Strike Stressors								
Vessels and in-water devices	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	No effect	No effect	No effect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	No effect	No effect	No effect
Military expended materials	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for the Preferred Alternative (Alternative 1) (continued)

Stressor		Salmonid Species	Salmonid Critical Habitat	Pacific Eulachon	Pacific Eulachon Critical Habitat	Green Sturgeon	Green Sturgeon Critical Habitat	Rockfish Species
Physical Disturbance and Strike Stressors (continued)								
Seafloor Devices	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Entanglement Stressors								
Fiber optic cables and guidance wires	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Decelerator/parachutes	Training	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
Ingestion Stressors								
Military expended materials other than munitions	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for the Preferred Alternative (Alternative 1) (continued)

Stressor		Salmonid Species	Salmonid Critical Habitat	Pacific Eulachon	Pacific Eulachon Critical Habitat	Green Sturgeon	Green Sturgeon Critical Habitat	Rockfish Species
Ingestion Stressors (continued)								
Munitions	Training	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect
	Testing	May affect, not likely to adversely affect	May affect, not likely to adversely affect*	May affect, not likely to adversely affect	No effect	May affect, not likely to adversely affect	May affect, not likely to adversely affect	May affect, not likely to adversely affect

* This conclusion is only for the chum and Chinook critical habitat in the Inland Waters of the Study Area; the other critical habitats are “no effect.”

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3.10 Cultural Resources

TABLE OF CONTENTS

3.10 CULTURAL RESOURCES 3.10-1
3.10.1 INTRODUCTION AND METHODS 3.10-1
3.10.1.1 Introduction 3.10-1
3.10.1.2 Identification, Evaluation, and Treatment of Cultural Resources 3.10-2
3.10.1.3 Methods 3.10-4
3.10.2 AFFECTED ENVIRONMENT 3.10-9
3.10.2.1 Known Wrecks, Obstructions, Occurrences, or Unknowns 3.10-9
3.10.2.2 Cultural Resources Eligible for or Listed in the National Register of Historic Places 3.10-12
3.10.2.3 Cultural Resources Eligible for or Listed in State Registers 3.10-14
3.10.2.4 Current Practices 3.10-14
3.10.3 ENVIRONMENTAL CONSEQUENCES 3.10-14
3.10.3.1 Acoustic Stressors 3.10-15
3.10.3.2 Physical Disturbance and Strike Stressors 3.10-22
3.10.3.3 Summary of Potential Impacts of All Stressors on Cultural Resources 3.10-33

LIST OF TABLES

TABLE 3.10-1: STRESSORS APPLICABLE TO CULTURAL RESOURCES FOR TRAINING AND TESTING ACTIVITIES 3.10-15
TABLE 3.10-2: SUMMARY OF SECTION 106 EFFECTS OF TRAINING AND TESTING ACTIVITIES ON CULTURAL RESOURCES 3.10-34

LIST OF FIGURES

FIGURE 3.10-1: KNOWN SHIPWRECKS AND OBSTRUCTIONS IN THE NORTHERN PORTION OF THE OFFSHORE AREA 3.10-10
FIGURE 3.10-2: KNOWN SHIPWRECKS AND OBSTRUCTIONS WITHIN THE INLAND WATERS 3.10-11
FIGURE 3.10-3: KNOWN SHIPWRECKS AND OBSTRUCTIONS IN THE SOUTHEAST ALASKA ACOUSTIC MEASUREMENT FACILITY AREA 3.10-13

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3.10 CULTURAL RESOURCES

CULTURAL RESOURCES SYNOPSIS

The United States (U.S.) Department of the Navy (Navy) considered all potential stressors and analyzed the following for submerged cultural resources:

- Acoustic (underwater explosions and cratering from underwater explosions)
- Physical disturbance (in-water devices, use of seafloor devices, and deposition of military expended materials)

Preferred Alternative (Alternative 1)

- Acoustic and Physical Disturbance: Acoustic and physical stressors, as indicated above, would not adversely affect submerged historic resources within U.S. territorial waters in accordance with Section 106 of the National Historic Preservation Act (NHPA). The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties. The Washington State Historic Preservation Office concurred with these findings. In accordance with Section 402 of the NHPA, no World Heritage sites would be affected.

3.10.1 INTRODUCTION AND METHODS

3.10.1.1 Introduction

Cultural resources are found throughout the Northwest Training and Testing Study Area (hereafter referred to as the Study Area). The approach to assessing cultural resources includes defining the resource; presenting the regulatory requirements for identifying, evaluating, and treating the resource within established jurisdictional parameters; establishing the specific resource subtypes in the Study Area; identifying the data used to define the current conditions; and describing the method of impact analysis.

Cultural resources are defined as districts, landscapes, sites, structures, objects, and ethnographic resources, as well as other physical evidence of human activity, that are considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources include archaeological resources, historic architectural resources, and traditional cultural properties. Native American and Alaska Native traditional resources (i.e., traditional hunting or gathering areas and usual and accustomed tribal fishing grounds) are discussed in Section 3.11.

Archaeological resources include prehistoric and historic sites and artifacts. Archaeological resources can have a surface component, a subsurface component, or both. Prehistoric resources are physical properties resulting from human activities that predate written records; they include village sites, temporary camps, lithic scatters, roasting pits, hearths, milling features, petroglyphs, rock features, and burials. Historic resources postdate the advent of written records in a region; they include building foundations, refuse scatters, wells, cisterns, and privies. Submerged cultural resources include historic shipwrecks and other submerged historic materials, such as sunken airplanes and piers. Architectural resources are elements of the built environment consisting of standing buildings or structures from the historic period. These resources include existing buildings, dams, bridges, lighthouses, and forts.

Resources that are significant to Native American and Alaska Native tribes that may be considered traditional cultural properties include, but are not limited to, archaeological sites and artifacts, locations of historic and contemporary events, sacred areas, landscapes, and sources of raw materials used to produce tools and sacred objects. Many resources are also sacred places important to Native Americans and may include mountain peaks, springs, and burial sites. Traditional uses may prescribe the use of particular native plants, animals, or minerals from specific places. The community may consider these resources essential for the continuation of their traditional culture. Traditional cultural properties are those resources listed in or eligible for listing in the National Register of Historic Places and are afforded the same protection as other types of historic properties. Traditional cultural properties are not limited to Native Americans but can represent any ethnic group with strong ties to the property (National Park Service 1998).

3.10.1.2 Identification, Evaluation, and Treatment of Cultural Resources

For the purposes of Section 106, the Study Area defined in Chapter 2 (Description of Proposed Action and Alternatives) of this document also serves as the Area of Potential Effects. To summarize, the Study Area is composed of established maritime operating and warning areas in the eastern north Pacific Ocean region, including the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. The area includes air and water space within Washington, as well as outside state waters of Oregon and Northern California. It includes four existing range complexes and facilities: the Northwest Training Range Complex (NWTRC); the Naval Undersea Warfare Center (NUWC) Division, Keyport; Carr Inlet Operating Area (OPAREA); and the Southeast Alaska Acoustic Measurement Facility (SEAFAC). In addition to these range complexes, the Study Area also includes United States (U.S.) Department of the Navy (Navy) pierside locations where sonar (sound navigation and ranging) maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities at Navy piers at Naval Base (NAVBASE) Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett.

Procedures for identifying, evaluating, and treating cultural resources within state territorial waters (within 3 nautical miles [nm] of the coast) and U.S. territorial waters (within 12 nm of the coast) are contained in a series of federal and state laws and regulations, as well as agency guidelines. Archaeological, architectural, and Native American resources are protected by various laws and their implementing regulations: the National Historic Preservation Act (NHPA) of 1966 as amended in 2006, the Archeological and Historic Preservation Act of 1974, the Archaeological Resources Protection Act of 1979, the American Indian Religious Freedom Act of 1978, the Native American Graves Protection and Repatriation Act of 1990, the Submerged Lands Act of 1953, the Abandoned Shipwreck Act of 1987, and the Sunken Military Craft Act of 2004. The Advisory Council on Historic Preservation (Advisory Council) further guides treatment of archaeological and architectural resources through the regulations, *Protection of Historic Properties* (36 Code of Federal Regulations [C.F.R.] Part 800). The category of "historic properties" is a subset of cultural resources defined in the NHPA (16 U.S. Code [U.S.C.] § 470w(5)) as any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places (National Register), including artifacts, records, and material remains related to such a property or resource.

Section 106 of the NHPA requires federal agencies to consider the effects of their actions on cultural resources listed in or eligible for inclusion in the National Register. The regulations implementing Section 106 (36 C.F.R. Part 800) specify a consultation process to assist in satisfying this requirement. Consultation with the appropriate State Historic Preservation Offices, the Advisory Council, Native American and Alaska Native tribes, the public, and state and federal agencies is required by Section 106

of the NHPA. Scoping letters for this Environmental Impact Statement (EIS)/Overseas EIS (OEIS) were sent to appropriate State Historic Preservation Offices.

Scoping letters for this EIS/OEIS were sent on 23 February 2012 to the following Native American and Alaska Native Tribes: Chinook Indian Nation, Confederated Tribes of the Chehalis Reservation, Cowlitz Indian Tribe, Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Lummi Tribe, Makah Tribe, Muckleshoot Indian Tribe, Nisqually Indian Tribe, Nooksack Indian Tribe, Port Gamble S'Klallam Tribe, Puyallup Tribe, Quileute Tribe, Quinault Nation, Samish Indian Tribe, Sauk-Suiattle Indian Tribe, Shoalwater Bay Tribe, Skokomish Indian Tribe, Snoqualmie Tribe, Squaxin Island Tribe, Stillaguamish Tribe, Suquamish Tribe, Swinomish Tribe, Tulalip Tribe, Upper Skagit Tribe, Confederated Tribes of Coos, Lower Umpqua, and Suislaw Indians, Confederated Tribes of Grand Ronde Community of Oregon, Confederated Tribes of Siletz Indians, Confederated Tribes of the Warm Springs Reservation, Coquille Indian Tribe, Cow Creek Band of Umpqua Indians, Klamath Tribes, Cahto Indian Tribe of the Laytonville Rancheria, Cher-Ae Heights Indian Community of the Trinidad Rancheria, Coyote Valley Band of Pomo Indians, Elk Valley Rancheria, Hoopa Valley Tribe, Hopland Band of Pomo Indians of the Hopland Rancheria, Karuk Tribe, Pinoleville Pomo Nation, Potter Valley Tribe, Redwood Rancheria of Pomo Indians, Robinson Rancheria of Pomo Indians, Round Valley Indian Tribes, Scotts Valley Band of Pomo Indians, Sherwood Valley Rancheria of Pomo Indians, Smith River Rancheria, Tolowa Nation, Wiyot Tribe, Yurok Tribe, Ketchikan Indian Community, Metlakatla Indian Community, and Organized Village of Saxman. Scoping letters dated 23 February 2012 were also sent to the Northwestern Indian Fisheries Commission, Skagit River System Cooperative, the InterTribal Sinkyone Wilderness Council, Cape Fox Corporation, Central Council of the Tlingit and Haida Indian Tribes, and Sealaska.

Additional regulations and guidelines for submerged historic resources include 10 U.S.C. § 113, note for the Sunken Military Craft Act; the *Abandoned Shipwreck Guidelines* prepared by the National Park Service (National Park Service 2007); and, for conducting research or recovering Navy ship and aircraft wrecks, the *Guidelines for Archaeological Research Permit Applications on Ship and Aircraft Wreck*s *under the Jurisdiction of the Department of the Navy* (36 C.F.R. Part 767) overseen by the Naval History and Heritage Command. The Sunken Military Craft Act does not apply to actions taken by, or at the direction of, the United States. In addition, the federal archaeological program developed by the National Park Service pursuant to a presidential order includes an ensemble of historical and archaeological resource protection laws to which federal managers adhere.

The addendum to the NHPA (16 U.S.C. § 470a-2, International Federal Activities Affecting Historic Properties) requires an assessment by federal agencies of project effects on resources outside U.S. territorial waters that are identified on the World Heritage List or on the applicable country's equivalent of the National Register of Historic Places. Two World Heritage resources, the Redwood National and State Parks in northern California and the Olympic National Park in Washington, are adjacent to the Study Area; however, no resources identified on the World Heritage List occur in the Study Area.

No specific procedures for identifying and protecting cultural resources in the open ocean have been defined by the international community (Zander and Varmer 1996). No treaty offering comprehensive protection of submerged cultural resources has been developed. A few international conventions prepared by the United Nations Educational, Scientific, and Cultural Organization apply to submerged cultural resources, including the 1970 Convention on the Means of Prohibiting and Preventing the Illicit Import, Export, and Transfer of Ownership of Cultural Property; the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage; the 1982 Convention on the Law of the Sea; and

the 2001 Convention on the Protection of the Underwater Cultural Heritage. Only the 1970 and 1972 conventions have been fully ratified by the United States.

3.10.1.3 Methods

3.10.1.3.1 Approach

3.10.1.3.1.1 Regulatory Requirements

Within the Pacific region, the approach for establishing current conditions is based on different regulatory parameters defined by geographical location. Within U.S. territorial waters (0–12 nm), the National Environmental Policy Act (NEPA) is applicable. The NHPA is applicable to state territorial waters and for any resources identified on the World Heritage List or on an applicable country's equivalent of the National Register of Historic Places beyond U.S. territorial waters in accordance with Section 402 (16 U.S.C. 470a-2, International Federal Activities Affecting Historic Properties). Executive Order (EO) 12114 mandates consideration of environmental effects of major federal actions located within the global commons, which are defined as geographical areas outside the jurisdiction of any nation, and include the oceans outside of the territorial limits (more than 12 nm from the coast). The order focuses on underwater acoustics, water quality, air quality, marine biology and essential fish habitat, and marine geology but also includes cultural resources. Specific cultural resources to be considered by EO 12114 include World Heritage Sites, submerged resources protected by international agreement, submerged resources entitled to sovereign immunity protected by the Sunken Military Craft Act, and submerged war graves also protected by the Sunken Military Craft Act.

The implementing regulations of Section 106 of the NHPA require federal agencies to take into account the effects that a proposed action would have on cultural resources included in or eligible for inclusion in the National Register. "Historic properties" is synonymous with National Register-eligible or -listed archaeological, architectural, or traditional resources. Cultural resources that have not been formally evaluated (e.g., a consensus determination in consultation with the State Historic Preservation Office) may be considered potentially eligible and thus are afforded the same regulatory consideration as resources listed in the National Register. Evaluations and determinations of historic properties within the Study Area are the responsibility of the federal agency, in consultation with State Historic Preservation Offices in Alaska and Washington. Consultations are not conducted with the State Historic Preservation Offices in Oregon or California because training and testing activities occur outside 12 nm from the coastline of these states, excluding the activities from state jurisdiction.

3.10.1.3.1.2 National Register of Historic Places Criteria

Properties are evaluated for nomination to the National Register and for National Register eligibility using the following criteria (36 C.F.R. § 60.4(a)-(d)):

- Criterion A: Associated with events that have made a significant contribution to the broad patterns of American history
- Criterion B: Associated with the lives of persons significant in the American past
- Criterion C: Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction
- Criterion D: Yield, or may be likely to yield, information important in prehistory or history

A historic property also must possess the aspects of integrity—location, design, setting, materials, workmanship, feeling, and association—to convey its significance and to qualify for the National

Register. These seven aspects, in various combinations, define integrity. To retain integrity, a property will always possess several, and usually most, of these aspects.

Cultural resources in U.S. territorial waters (within 12 nm of the coastline) are defined as follows:

- Resources listed in or eligible for listing in the National Register (Section 106 of the NHPA)
- Resources entitled to sovereign immunity (e.g., Russian brigs)

3.10.1.3.1.3 Previous Section 106 Consultation

The Navy previously conducted Section 106 consultations for the training and testing activities included in the No Action Alternative. These consultations were completed with activities at the NWTRC; the NUWC Division, Keyport; and SEAFAC. On 18 March 2009, the Washington State Historic Preservation Office concurred with the Navy's finding of No Historic Properties Affected for activities proposed in the NUWC Division, Keyport Range Complex Extension (Whitlam 2009a). On 5 November 2009, the Washington State Historic Preservation Office concurred with the Navy's finding of No Adverse Affect to Historic Properties for activities proposed in the NWTRC (Whitlam 2009b). In each letter, the Washington State Historic Preservation Office asked to receive any correspondence or comments from concerned tribes or other parties. It also stipulated that should archaeological or historic materials be discovered during project activities, work in the immediate vicinity would stop, the area would be secured, and concerned tribes and the State Historic Preservation Office would be notified. Section 106 consultation between the Alaska State Historic Preservation Office, the U.S. Forest Service, and the Advisory Council on Historic Preservation was conducted in 1989 for the construction of naval facilities on Back Island associated with SEAFAC. Submerged cultural resources within the Western Behm Canal were not included in the consultation.

In September 2003, the Navy sent scoping letters to associated Native American tribes regarding the NUWC Division, Keyport Range Complex Extension EIS/OEIS. The Navy solicited feedback on the Draft EIS/OEIS in September 2008, and government-to-government consultations occurred as part of Section 106 compliance for the NUWC Division, Keyport Range Complex Extension EIS/OEIS between October 2008 and March 2009. The following Native American tribes and nations were involved in these consultations (listed in alphabetical order): Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Makah Tribe, Port Gamble S'Klallam Tribe, Quileute Tribe, Quinault Nation, Skokomish Indian Tribe, and Suquamish Tribe. In addition, the Point No Point Treaty Council was notified. The Navy responded to the tribes' comments and concerns on the NUWC Keyport Range Complex Extension Draft EIS/OEIS in the response to comments section of the Final EIS/OEIS, and edits were made to the text of the document as required.

In July 2007, the Navy sent scoping letters inviting associated Native American tribes to be involved in public participation efforts associated with the NWTRC EIS/OEIS. Comments were also solicited during public review of the Draft EIS/OEIS from December 2009 to April 2010. In fulfillment of Section 106 obligations for completion of the EIS/OEIS, the Navy considered comments from Native American tribes resulting from communications during the NEPA process. The following Washington tribes were invited to participate in government-to-government consultation (listed in alphabetical order): Hoh Indian Nation, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Lummi Tribe, Makah Tribe, Nisqually, Nooksack, Northwestern Indian Fisheries Commission, Point No Point Treaty Council, Port Gamble S'Klallam Tribe, Puyallup, Quileute Tribe, Quinault Nation, Sauk-Suiattle, Skokomish Indian Tribe, Squaxin Island, Stillaguamish, Suquamish Tribe, Swinomish Tribe, Tulalip Tribe, and Upper Skagit Tribe. The following Oregon and California tribes were also invited to participate in government-to-

government consultations (listed in alphabetical order): Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians; Confederated Tribes of Grande Ronde; Confederated Tribes of Siletz; Confederated Tribes of the Umatilla Indian Reservation; Confederated Tribes of the Warm Springs Reservation; Coquille Tribe; Cow Creek Band of Umpqua Tribe; Klamath Tribes (Klamath, Modoc, Yahooskin); Tolowa Nation/Trinidad Rancheria; Upper Shoal Water Tribe; and Yurok Indian Reservation. No government-to-government consultation was requested, and all communication with the Navy was conducted through tribal staff. Comments expressing concern related to several topics, including impacts on usual and accustomed fishing rights, communication protocols between the Navy and tribes, and safety of tribal fishing vessels, were provided by the tribes. The Navy responded to the tribes' comments and concerns on the NWTRC Draft EIS/OEIS in the response to comments section of the Final EIS/OEIS, and revisions were made to the text of the document as required.

3.10.1.3.2 Data Sources

Cultural resources information relevant to this EIS/OEIS was derived from various sources, including previous environmental documents, shipwreck databases, the National Register Information System (managed by the National Park Service), online information repositories associated with State Historic Preservation Offices, online maps and data, and published sources, as cited. Previous environmental documents used for general information include the *Northwest Training Range Complex EIS/OEIS* (U.S. Department of the Navy 2010a) and the *NAVSEA NUWC Keyport Range Complex Extension EIS/OEIS* (U.S. Department of the Navy 2010b).

The online National Register Information System was reviewed to identify National Register-listed properties, historic districts, and National Historic Landmarks. Appropriate information associated with the State Historic Preservation Offices' repositories was obtained from previous documents, and their online databases were reviewed for information on submerged resources, types, and eligibility for listing in the National Register.

3.10.1.3.3 Cultural Context

Several types of historic properties may be present in the Study Area, including wrecks of ships, submarines, aircraft, and barges; sunken navigational equipment such as buoys; and man-made obstructions. The context within which these types of resources were formed provides an understanding of the overall development of the resource base and information on relative locations.

As the result of mechanical, chemical, and biological erosion and decay, historic shipwrecks exhibit differential preservation. Shipwrecks in high-energy zones, as in shallow waters along the coastlines, are generally less well preserved because they have been scoured by the abundant fluvial sediments driven by coastal currents and heavy wave action (Pearson et al. 2003). However, if portions of the shipwreck are buried in sediment and protected from scouring, preservation may be high. Ferrous metal oxidation is accelerated by elevated seawater temperature, and shipworms consume wooden ship members. Deep-water wrecks may be better preserved because the lower seawater temperatures at depth slow the oxidation of ferrous metals and reduce the number of wood-eating shipworms; however, preservation of deep-water shipwrecks does vary (Pearson et al. 2003).

In accordance with the Abandoned Shipwreck Act, abandoned shipwrecks in state waters on the Pacific coast are considered the property of the U.S. government (Barnette 2010). Warships or other vessels used for military purposes at the time of their sinking retain sovereign immunity (e.g., Russian brigs). According to the principle of sovereign immunity, foreign warships sunk in U.S. territorial waters are

protected by the U.S. government, which acts as custodian of the sites in the best interest of the sovereign nation (Neyland 2001).

Estimated numbers of historic submerged resources used in this EIS/OEIS are compiled from various information sources. Data changes are made yearly as exploration systems become more sophisticated and additional discoveries are made. Because no comprehensive survey or evaluation of submerged historic resources has occurred for the entire Study Area, discoveries of additional submerged historic resources may occur. Additionally, some existing and unrecorded submerged historic resources could be considered eligible for the National Register.

3.10.1.3.3.1 Offshore Area

The Offshore Area contains submerged historic resources primarily associated with maritime trade, transport, and military activities, and it includes many shipwrecks. In particular, the Olympic coast of Washington is a ship graveyard as a result of the isolated, rocky shores, heavy ship traffic, and ferocious weather and wave action. These conditions have resulted in numerous founderings, collisions, and groundings. Some ships simply disappeared, with a last known location recorded by a lighthouse tender.

3.10.1.3.3.2 Inland Waters

The coastal region of the northwestern United States was largely shaped by a series of glacial events and changes in sea level, with subsequent emergence of land masses and deposition of glacial till and outwash. Before and during the glacial period, active volcanoes contributed to formation of some of the existing landforms (Blukis Onat 1994). Present-day shorelines and islands resulted from both the erosion and deposition of natural materials.

Continuing human occupation and use of the northern Puget Sound region dates to perhaps 8,000 years ago. Prehistoric northwest coast peoples lived in an area with a relatively mild climate, temperate rain forest, and rich marine life. Cultural adaptations to this environment varied somewhat among tribes, but generally these groups were nonhorticultural peoples whose basic food sources included salmon, shellfish, land mammals, berries, freshwater fish, and wild plants. Vegetable foods included camas roots and lily bulbs supplemented by berries and nuts. Net traps or spears were used to capture waterfowl, and bows and arrows were used for game.

Among the northwest tribes, fishing, especially the taking of salmon and steelhead, was universally important as an element of diet and, in cultural traditions, in religious practices and trade. The northwest groups developed a wide variety of fishing methods such as nets, traps, weirs, spears, and hook and line, which they used to catch fish at numerous locations throughout the areas they lived and traveled. Species taken included coho, Chinook, pink, sockeye, and chum salmon; rockfish; perch; ling cod; halibut; herring; smelt; and trout. They gathered numerous shellfish species, including cockles, clams, saltwater snails, oysters, barnacles, crab, chitons, and mussels (U.S. Department of the Navy 1997).

With a few exceptions, northwest coast peoples occupied permanent villages in winter, and many had permanent structures for other seasons (Suttles 1990). Their cedar-plank dwellings typically housed several related families. They often settled along the estuaries of small rivers and along the open coastline where intertidal, estuarine, and marine resources were available for subsistence uses.

Northwest coast material culture is distinctive for its highly developed woodworking technology that produced plank houses, dugout canoes, and beautifully crafted utensils. Renowned art work included carving, painting, and textiles.

3.10.1.3.3.3 Western Behm Canal, Alaska

The following cultural history is adapted and excerpted from the National Park Service (2012):

The southeastern region of Alaska, also known as the Alaska Panhandle, stretches from the Copper River delta and the Malaspina Forelands, past the Alexander Archipelago south to the northern end of the Queen Charlotte Islands (at the Dixon Entrance to Hecate Strait) in a narrow arc extending along the North Pacific coast. Sharply bounded on the inland side by mountain ranges, this zone is radically different in climate, vegetation, and fauna from the regions beyond the mountains. The coastal strip features a relatively mild climate, temperate rain forest, and rich marine life. There are two coastal environments in the zone: outer coast and inner coast. The famed Inside Passage of Alaska, a sheltered coastline separated from the open ocean by the islands of the Alexander Archipelago, provided a protected marine environment for exploitation. Areas north of this region were exposed to the open Pacific and Gulf of Alaska, a much more difficult ecological zone that experienced less of a classic Northwest Coast cultural development.

The “classic” views of the Pacific Northwest as a culture have been modified over the years, but the basic perception of cultural unity with many cultural traits shared up and down the coast has persisted. This culture is characterized by a nonhorticultural subsistence style based on hunting and gathering. Because of the richness and predictability of such resources (e.g., fishing for salmon and halibut, sea mammal hunting, shellfish, plants, berries), surpluses were generated, and a complex sociocultural system developed along with an elaborate and distinctive art style. Material culture was distinctive in its highly developed and elaborate woodworking technology that produced plank houses, bowls, canoes, monuments, boxes, and many other tools and utensils. A highly developed twined basketry was also notable, as were textiles of wool and vegetable fiber. Permanent winter villages or towns were a standard settlement pattern.

The evolution of the historic, “classic” Northwest Coast culture, with its coastal subsistence focus and stratified, complex social organization, has been attributed to the differential access of groups to the major and stable resources of the area such as streams with major salmon runs. The ability to harvest and accumulate surpluses of these resources led to more wealth and power for some groups than others—with property, increased population, and influence. A highly developed art and oral culture, warfare, slavery, extensive trading relationships, sophisticated technology, and institutions such as the potlatch became widespread up and down the coast.

Beginning in 1741, with Bering's second expedition that touched on the northwest coast, European contact continued and increased. Russian exploitation of sea otter fueled continued expansion and settlement from the Aleutians. Russians made solid contact with the Eyak and Tlingit by 1780. By 1779, Spanish explorers had reached as far north as southeastern Alaska. James Cook's third voyage, in 1778, reached Nootka Sound and the Gulf of Alaska. Lituya Bay was explored by the French under LaPerouse in 1786. A Spanish scientific expedition under the leadership of Malaspina reached Yakutat Bay in 1791. Sitka was founded by the Russians in 1799 and destroyed by the Tlingit in 1802. The Tlingit fort was destroyed in 1804 by the Russians, and the first permanent European base on the Northwest Coast was built at Novo-Arkhangel’sk. American purchase of Alaska in 1867 led to further settlement and

exploitation of the region. The Klondike Gold Rush of 1898, followed by a series of other gold rushes, led to the opening of Alaska, which has continued to this day (National Park Service 2012).

3.10.2 AFFECTED ENVIRONMENT

The affected environment is discussed relative to known wrecks, obstructions, occurrences, or unknowns; cultural resources eligible for or listed in the National Register of Historic Places; and cultural resources eligible for or listed in state registers. Within these categories, the Study Area is divided into three distinct regions for cultural resources evaluation: the Offshore Area, the Inland Waters, and Western Behm Canal, Alaska. In accordance with an addendum to the NHPA, only potential impacts on World Heritage sites will be addressed in areas beyond 12 nm; however, no resources identified on the World Heritage List occur in the Study Area.

3.10.2.1 Known Wrecks, Obstructions, Occurrences, or Unknowns

3.10.2.1.1 Offshore Area

At Washington, the eastern boundary of the Offshore Area abuts the coastline and includes a 1-mile-wide surf zone of Quinault Range Site. This portion of the study area contains many known shipwrecks. As shown in Figure 3.10-1, more than 150 wrecks have been documented near the Olympic Coast National Marine Sanctuary (National Oceanic and Atmospheric Administration 2008). Along the shorelines of the sanctuary are memorials to crews and passengers who died in nearby shipwrecks. These include the wrecks of the *Prince Arthur* in 1903, the *P.J. Pirrie* in 1920, nine ships wrecked between Quillayute Rocks and Cape Alava, five at Destruction Island, and four near Hoh Head (National Oceanic and Atmospheric Administration 1993).

At Oregon and in Northern California, the Study Area boundary is 12 nm off the coastline. At this distance, states and their associated State Historic Preservation Offices do not have jurisdiction. If cultural resources were discovered, these resources would not be listed on either the state registers or the National Register of Historic Places because they are beyond state and U.S. territorial waters.

3.10.2.1.2 Inland Waters

The Strait of Juan de Fuca and Puget Sound contain an extensive collection of wrecks (Figure 3.10-2) (Northern Maritime Research 2007). For example, six known shipwrecks are in waters adjacent to NAVBASE Kitsap Bangor, while 105 are in the Crescent Harbor area.

Obstructions and wrecks are listed in the National Oceanic and Atmospheric Administration Automated Wreck and Obstruction Information System database. In this area, most shipwrecks are of unknown origin, date of sinking, or type (National Oceanic and Atmospheric Administration 2008). Those that have been identified date from the early 1800s (including the Hudson Bay supply ship *Isabella*, which sank around 1830) to modern fishing boats, barges, cabin cruisers, and tugs. Some of the vessels were cargo ships and freighters damaged during World War II. A mine sweeper, the *USS Crow*, was sunk by an erratic-running aircraft torpedo in the Puget Sound in 1943 (Naval Historical Center 2004). Some ships were deliberately sunk to create artificial habitats or reefs.

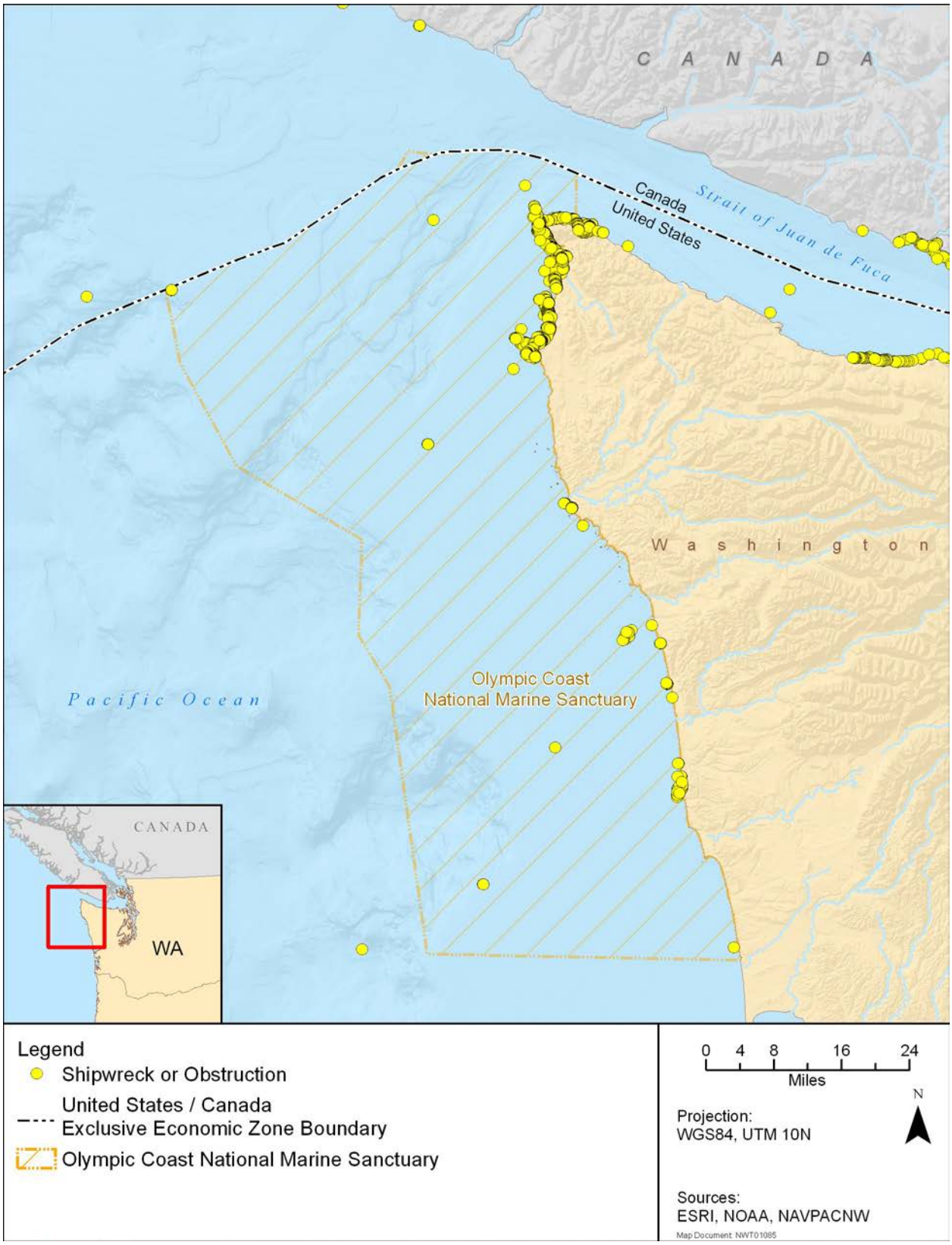

Figure 3.10-1: Known Shipwrecks and Obstructions in the Northern Portion of the Offshore Area

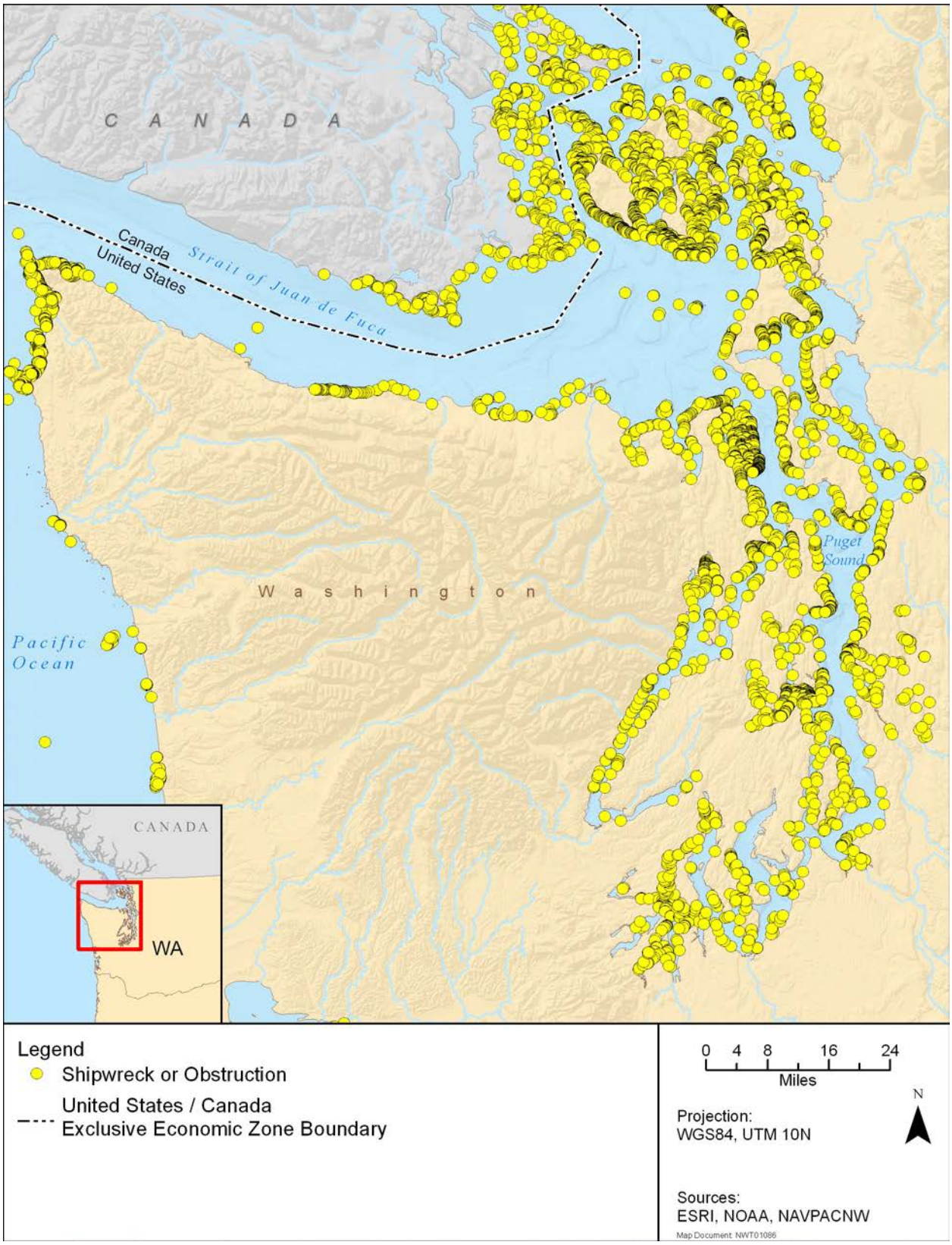

Figure 3.10-2: Known Shipwrecks and Obstructions within the Inland Waters

The numerous shipwrecks reflect a wide variety of ship types and countries of origin, including:

- A three-masted square-rigger, later rerigged as a bark to make her more suitable for trade among Pacific coast ports
- An iron barkentine-rigged steam sloop
- An iron, three-masted bark
- A clipper ship used in the guano trade
- A merchant marine ship
- A wooden sailing vessel
- A side-wheeler
- A steam schooner
- A passenger steamer
- An 1808 Russian sailing brig (for the fur trade)
- A British freighter
- An iron-hulled, four-masted bark refitted as a schooner-barge

Ten shipwrecks are within or near the NUWC Division, Keyport (U.S. Department of the Navy 2003, Northern Maritime Research 2007): the *Laurel*, the *Elk*, the *A.R. Robinson*, the *R.M. Hasty*, the *Orion*, the *B.C. Company No. 4*, the *Union*, the *Curlew*, the *Nokomis*, and an unnamed vessel.

3.10.2.1.3 Western Behm Canal, Alaska

The Bureau of Ocean Energy Management's Alaskan shipwreck inventory was used to identify existing records of shipwrecks near the Study Area. The agency provides the most comprehensive compilation of Alaska shipwrecks to date. The database lists shipwrecks in Alaska from earliest Russian times (1741) to the present, as compiled from an extensive literature search. The electronic database was updated in May 2011 (Bureau of Ocean Energy Management 2012). Queries were completed for Behm Canal and other named areas in the immediate vicinity of the SEAFAC Restricted Area, including Clover Passage, Clover Pass, Naha Bay, Bond Bay, Helm Bay, Wading Cove, and Raymond Cove. The results of the search indicated the presence of 29 shipwrecks within or near the Study Area (Figure 3.10-3). These included steamers, a skiff, a ferry, a salmon troller, and numerous gas screws.

3.10.2.2 Cultural Resources Eligible for or Listed in the National Register of Historic Places

3.10.2.2.1 Offshore Area

To determine the potential presence of cultural resources in the Study Area eligible for or listed in the National Register, the National Register Information System online database was searched by county, and prior compliance documents were reviewed. No cultural resources or traditional cultural properties were identified.

3.10.2.2.2 Inland Waters

To determine the potential presence of cultural resources in the Study Area eligible for or listed in the National Register, the National Register Information System online database was searched by county, and prior compliance documents were reviewed. No cultural resources or traditional cultural properties were identified.

3.10.2.2.3 Western Behm Canal, Alaska

To determine the potential presence of cultural resources in the Study Area eligible for or listed in the National Register, the National Register Information System online database was searched by county, and prior compliance documents were reviewed. No cultural resources or traditional cultural properties were identified.

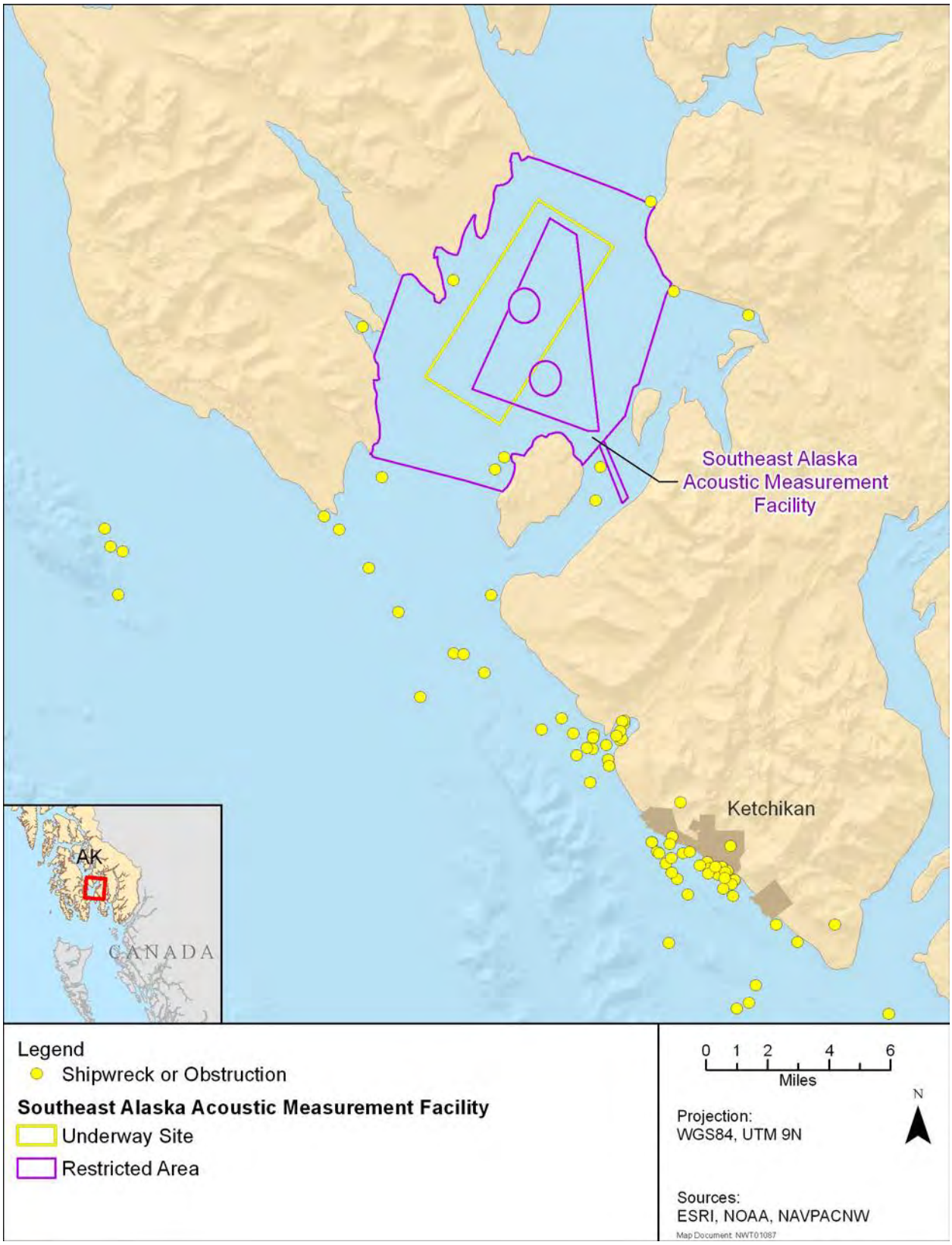

Figure 3.10-3: Known Shipwrecks and Obstructions in the Southeast Alaska Acoustic Measurement Facility Area

3.10.2.3 Cultural Resources Eligible for or Listed in State Registers

3.10.2.3.1 Offshore Area

To determine the potential presence of cultural resources in the Study Area eligible for or listed in state registers, state online databases were searched and prior compliance documents were reviewed. No cultural resources were identified.

3.10.2.3.2 Inland Waters

To determine the potential presence of cultural resources in the Study Area eligible for or listed in state registers, state online databases were searched and prior compliance documents were reviewed. No cultural resources were identified.

3.10.2.3.3 Western Behm Canal, Alaska

To determine the potential presence of cultural resources in the Study Area eligible for or listed in state registers, state online databases were searched and prior compliance documents were reviewed. No cultural resources were identified.

3.10.2.4 Current Practices

The Navy has established protective measures to reduce potential effects on cultural resources from training and testing exercises. The Navy routinely avoids known submerged obstructions, including submerged cultural resources such as historic shipwrecks. Known obstructions are avoided to prevent damage to sensitive Navy equipment and vessels and to ensure the accuracy of training and testing exercises.

3.10.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact cultural resources of the Study Area. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including numbers of events and ordnance expended). Appendix A describes the warfare areas and associated stressors that were considered for analysis of cultural resources. The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to cultural resources include:

- Acoustic Stressors
  - Impacts from underwater explosions – shock (pressure) waves
  - Impacts from underwater explosions – cratering
- Physical Stressors
  - Impacts from in-water device strikes
  - Impacts from seafloor devices
  - Impacts from deposition of military expended materials

Sonar and other non-impulse sources do not affect the structural elements of historic shipwrecks and, therefore, an in-depth analysis of sonar impacts will not be included in this section. Archaeologists regularly use multibeam sonar and sidescan sonar to explore shipwrecks without disturbing them. Based on the physics of underwater sound, the shipwreck would need to be very close (< 22 feet [ft.] [< 6.7 meters {m}]) to the sonar sound source for the shipwreck to experience even slight oscillations from the induced pressure waves. Any oscillations experienced at a depth of less than 22 ft. (6.7 m)

would be negligible up to within a few yards from the sonar source. This distance is smaller than the typical safe navigation and operating depth for most sonar sources; therefore, sonar sources are not expected to impact historic shipwrecks.

Based on an initial screening of potential impacts of sonar maintenance and testing, pierside locations have been eliminated from detailed consideration in the analysis of impacts on cultural resources based on the extremely limited potential for active sonar to damage adjacent historic properties.

Table 3.10-1 presents quantitative data (number of components or activities) for the analysis of each stressor applicable to cultural resources. The specific analysis of the training and testing activities presented in this section considers relevant components and associated data with the geographic location of the activity and the resource. Training activities are not proposed in the Western Behm Canal; therefore, only the Offshore Area and the Inland Waters will be analyzed under Training Activities.

Table 3.10-1: Stressors Applicable to Cultural Resources for Training and Testing Activities

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Acoustic Stressors							
Underwater explosions – IEER and SUS buoys	Offshore Area	150	0	150	142	150	156
	Inland Waters	0	0	0	0	0	0
	W. Behm Canal	0	0	0	0	0	0
Underwater explosions – EOD	Offshore Area	0	0	0	0	0	0
	Inland Waters	4	0	42	0	42	0
	W. Behm Canal	0	0	0	0	0	0
Physical Disturbance and Strike Stressors							
Activities including in-water devices	Offshore Area	429	40	484	154	484	183
	Inland Waters	0	379	1	648	1	716
	W. Behm Canal	0	0	0	0	0	0
Military expended materials	Offshore Area	189,668	621	196,888	2,511	196,888	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Activities including seafloor devices	Offshore Area	0	5	0	6	0	7
	Inland Waters	2	210	16	225	16	239
	W. Behm Canal	0	0	0	5	0	15

Notes: (1) The values presented include the entire Offshore Area for training activities; however, only 3 percent of Warning Area 237 occurs within the 3–12 nm limit. Therefore, the number of activities analyzed is limited to this portion of the Offshore Area.
(2) IEER = Improved Extended Echo Ranging; SUS = Signal, Underwater Sound; EOD = Explosive Ordnance Disposal; nm = nautical miles

3.10.3.1 Acoustic Stressors

Acoustic stressors that could impact cultural resources are vibration and shock (pressure) waves from underwater explosions, as well as cratering created by underwater explosions. A shock wave and oscillating bubble pulses resulting from underwater explosions associated with the use of torpedoes,

missiles, bombs, projectiles, mines, and improved extended echo ranging sonobuoys could impact the exposed portions of nearby submerged historic resources. Shock waves (pressure) generated by underwater explosions would be periodic rather than continuous and could create overall structural instability and eventual collapse of architectural features of submerged historic resources. The amount of damage would depend on factors such as the size of the charge, the distance from the historic shipwreck, the water depth, and the topography of the ocean floor.

3.10.3.1.1 Impacts from Explosive Shock (Pressure) Waves from Underwater Explosions

Anti-surface missiles and projectiles explode at or within 3 ft. (1 m) below the ocean surface. Shockwaves (pressure) from these types of explosions within the water column would not reach historic resources on the ocean floor. Underwater detonations of improved extended echo ranging sonobuoys or other types of explosive rounds would occur well below the surface and on or near the ocean bottom. Shock waves from nearby underwater detonations may damage the exposed portions of historic shipwrecks because water rapidly transmits shock waves. The amount of damage from an underwater explosion would depend on factors such as the size of the explosive charge, the distance from the historic shipwreck, and the topography of the seafloor.

3.10.3.1.1.1 No Action Alternative

Training Activities

Offshore Area

Under the No Action Alternative, training activities would continue at current levels within existing designated areas in the Offshore Area (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Consequently, no impacts on cultural resources are expected from shock waves created by underwater detonations.

Inland Waters

Under the No Action Alternative, training activities would continue at current levels within existing designated areas within the Inland Waters (see Table 3.10-1), specifically Crescent Harbor and Hood Canal Explosive Ordnance Disposal (EOD) Ranges. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Consequently, no impacts on cultural resources are expected from shock waves created by underwater detonations.

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives during training activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under the No Action Alternative, there are no testing activities in the Offshore Area that include underwater explosions (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions at depth to affect submerged historic resources.

Inland Waters

Under the No Action Alternative, no testing activities in the Inland Waters include underwater detonations (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions to affect submerged historic resources.

Western Behm Canal, Alaska

No testing activities in the Western Behm Canal include underwater detonations under any alternative (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions to affect submerged historic resources.

The Navy does not propose to use underwater explosives during testing activities under the No Action Alternative. Therefore, in regard to Section 106 of the National Historic Preservation Act, there is no potential for shock waves from underwater explosions to adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.1.1.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, the use of improved extended echo ranging sonobuoy or other explosive-round detonations in the Offshore Area would continue at current levels as in the No Action Alternative (see Table 3.10-1). Training would continue at existing ranges where the Navy currently trains. Therefore, effects from training in the Offshore Area would be the same as described in Section 3.10.3.1.1.1 (No Action Alternative).

Inland Waters

Under Alternative 1, the number and type of underwater detonations associated with mine neutralization in the Inland Waters would increase from the No Action Alternative (see Table 3.10-1). The Navy previously analyzed impacts that could result from the same or relatively similar underwater detonations at these sites and concluded there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). In Alternative 1, explosives training would increase from two 2.5-pound (lb.) and two 1.5 lb. underwater detonations at Crescent Harbor and Hood Canal, respectively, to three 2.5 lb. underwater detonations at each location. Additionally, under Alternative 1, six annual events would take place (three each at Crescent Harbor and Hood Canal) in which up to six shock wave action generators (SWAG) would be used per event. Each SWAG consists of a small explosive charge of less than 0.5 ounce. Of the increase in underwater detonations from the No Action Alternative to Alternative 1, 36 of the 42 would be these much smaller SWAG detonations. Furthermore, known historic shipwrecks, obstructions, and archaeological sites are avoided during training exercises. As a result, no effects on cultural resources from shock waves created by underwater detonations at depth are expected.

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives during training activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 1, underwater explosions would be introduced in the Offshore Area (see Table 3.10-1). However, the No Action Alternative includes testing activities that involve this stressor, which were previously analyzed by the Navy and concluded to result in no adverse effects on historic properties. The Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, known historic shipwrecks, obstructions, and archaeological sites are avoided during testing. As a result, no effects on cultural resources from shock waves created by underwater detonations are expected.

Inland Waters

Under Alternative 1, no testing activities in the Inland Waters include underwater detonations (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions to affect submerged historic resources.

Western Behm Canal, Alaska

No testing activities in the Western Behm Canal include underwater detonations under any alternative (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions to affect submerged historic resources.

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives during testing activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.1.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the use of improved extended echo ranging sonobuoy or other explosive-round detonations in the Offshore Area would continue at current levels as in the No Action Alternative (see Table 3.10-1). Training would continue at existing ranges where the Navy currently trains. Therefore, effects from training in the Offshore Area would be the same as described in Section 3.10.3.1.1.1 (No Action Alternative).

Inland Waters

Under Alternative 2, the number and type of underwater detonations associated with mine neutralization in the Inland Waters would increase from the No Action Alternative as described under Alternative 1 (see Table 3.10-1). However, effects from training in the Inland Waters would be similar as described in Section 3.10.3.1.1.2 (Alternative 1).

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives during training activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 2, underwater explosions would be introduced in the Offshore Area and conducted at a slightly higher frequency than under Alternative 1 (see Table 3.10-1). However, the No Action

Alternative includes testing activities that involve this stressor, which were previously analyzed by the Navy and concluded to result in no adverse effects on historic properties. The Washington State Historic Preservation Office concurred with this finding. Furthermore, known historic shipwrecks, obstructions, and archaeological sites are avoided during testing. As a result, no effects on cultural resources from shock waves created by underwater detonations are expected.

Inland Waters

Under Alternative 2, no testing activities in the Inland Waters include underwater detonations (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions to affect submerged historic resources.

Western Behm Canal, Alaska

No testing activities in the Western Behm Canal include underwater detonations under any alternative (see Table 3.10-1). Therefore, there is no potential for shock waves from underwater explosions to affect submerged historic resources.

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives during testing activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.1.2 Impacts from Explosives – Cratering

Underwater explosions at depth or on or near the ocean bottom could displace sediment and leave a crater. Cratering could affect submerged historic resources (e.g., shipwrecks) at or near the point of detonation. Cratering of unconsolidated, soft-bottom habitats would result from mine neutralization charges set on or near the bottom. These relatively small (no greater than 2.5 lb.) charges are set by Navy divers in shallow waters. Cratering could disrupt or destroy features of unidentified historic shipwrecks and unrecorded historic resources and could destroy those characteristics that would make them eligible for listing in the National Register of Historic Places.

3.10.3.1.2.1 No Action Alternative

<u>Training Activities</u>

Offshore Area

Under the No Action Alternative, no training activities in Offshore Area include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Inland Waters

Under the No Action Alternative, training activities in the Inland Waters that include underwater explosions would continue at current levels within existing designated areas (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Consequently, no impacts on cultural resources are expected by cratering caused by underwater explosions.

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives at or near the ocean bottom during training activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under the No Action Alternative, no testing activities in Offshore Area include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Inland Waters

Under the No Action Alternative, no testing activities in the Inland Waters include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Western Behm Canal, Alaska

No testing activities in the Western Behm Canal include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

The Navy does not propose to use underwater explosives at or near the ocean bottom during testing activities under the No Action Alternative. Therefore, with regard to Section 106 of the National Historic Preservation Act, there is no potential for cratering from underwater explosions to adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.1.2.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, no training activities in Offshore Area include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Inland Waters

Under Alternative 1, the number of detonations in the Inland Waters associated with mine warfare exercises would increase from the No Action Alternative (see Table 3.10-1). Training would continue at the existing Crescent Harbor and Hood Canal EOD Ranges, where the Navy currently trains. The Navy previously analyzed impacts that could result from these activities and concluded that there would either be no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources are expected by cratering caused by underwater explosions.

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives at or near the ocean bottom during training activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 1, no testing activities in Offshore Area include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Inland Waters

Under Alternative 1, no testing activities in the Inland Waters include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Western Behm Canal, Alaska

No testing activities in the Western Behm Canal include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

The Navy does not propose to use underwater explosives at or near the ocean bottom during testing activities under Alternative 1. Therefore, in accordance with Section 106 of the National Historic Preservation Act, there is no potential for cratering from underwater explosions to adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.1.2.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, no training activities in Offshore Area include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Inland Waters

Under Alternative 2, the number of detonations in the Inland Waters associated with mine warfare exercises would increase from the No Action Alternative as described under Alternative 1 (see Table 3.10-1). Therefore, impacts from training in the Inland Waters would be similar as described in Section 3.10.3.1.2.2 (Alternative 1).

In accordance with Section 106 of the National Historic Preservation Act, the use of underwater explosives at or near the ocean bottom during training activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 2, no testing activities in Offshore Area include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Inland Waters

Under Alternative 2, no testing activities in the Inland Waters include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

Western Behm Canal, Alaska

No testing activities in the Western Behm Canal include underwater explosions at depth or on or near the ocean bottom (see Table 3.10-1). Therefore, there is no potential for cratering from underwater explosions to affect submerged historic resources.

The Navy does not propose to use underwater explosives at or near the ocean bottom during testing activities under Alternative 2. Therefore, in regard to Section 106 of the National Historic Preservation Act, there is no potential for cratering from underwater explosions to adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2 Physical Disturbance and Strike Stressors

Any physical disturbance on the continental shelf and seafloor, such as targets or mines resting on the seafloor, moored mines, bottom-mounted tripods, unmanned underwater vehicles, or bottom crawlers, could inadvertently damage or destroy submerged historic resources. Use of a towed system and attachment cable could inadvertently encounter, snag, damage, and/or destroy unknown historic resources in shallow water if such resources are within the training and testing areas. Expended materials such as chaff, flares, projectiles, casings, target or missile fragments, non-explosive practice munitions, rocket fragments, ballast weights, sonobuoys, torpedo launcher accessories, or mine shapes could be deposited on the ocean bottom on or near submerged historic resources. Heavier expended materials could damage intact fragile shipwreck features if they landed with sufficient velocity on a resource.

3.10.3.2.1 Impacts from In-Water Devices

Activities including in-water devices as discussed in this analysis employ unmanned vehicles such as remotely operated vehicles, unmanned surface and undersea vehicles, and towed devices. These devices are self-propelled and unmanned or towed through the water from a variety of platforms, including helicopters and surface ships. Towed systems and attachment cables could inadvertently encounter, snag, damage, or destroy historic resources in relatively shallow water, especially during low tide, if such resources are within the Study Area. Before deploying an in-water device, it is standard operating procedure to search the intended path of the device for any floating debris (e.g., driftwood) or other potential surface obstructions because they have the potential to damage the device.

3.10.3.2.1.1 No Action Alternative

<u>Training Activities</u>

Offshore Area

Under the No Action Alternative, training activities with the potential for impacts from activities including in-water devices would continue at current levels in existing designated areas within the Offshore Area (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources are expected by activities including in-water devices.

Inland Waters

Under the No Action Alternative, no training activities with the potential for impacts from activities including in-water devices occur within the Inland Waters (see Table 3.10-1).

In accordance with Section 106 of the National Historic Preservation Act, the use of in-water devices during training activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under the No Action Alternative, testing activities with the potential for impacts from activities including in-water devices would continue at current levels in existing designated areas within the Offshore Area (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. Therefore, submerged historic resources would not be affected by testing included in the No Action Alternative.

Inland Waters

Under the No Action Alternative, testing activities with the potential for impacts from activities including in-water devices would continue at current levels in existing designated areas within the Inland Waters (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources from activities including in-water devices are expected.

Western Behm Canal, Alaska

There are no testing activities in the Western Behm Canal with the potential for impacts from activities including in-water devices (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the use of in-water devices during testing activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.1.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, the number of anti-submarine warfare and mine warfare training activities with potential for impacts from activities including in-water devices would increase from the No Action Alternative (see Table 3.10-1). In-water devices would be deployed in areas currently used for training. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources by activities including in-water devices are expected.

Inland Waters

Under Alternative 1, the Navy proposes to conduct one activity (Maritime Homeland Defense/Security Mine Countermeasures Integrated Exercise, conducted once every 2 years) that would have the potential for impacts from activities including in-water devices (see Table 3.10-1). In-water devices would be deployed in areas currently used for training but would also be deployed in additional areas. The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources from activities including in-water devices are expected.

In accordance with Section 106 of the National Historic Preservation Act, the use of in-water devices during training activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 1, testing activities in the Offshore Area with the potential for impacts from the use of in-water devices would increase from the No Action Alternative (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. Therefore, submerged historic resources would not be affected by testing included in Alternative 1.

Inland Waters

Under Alternative 1, testing involving activities using in-water devices would increase (see Table 3.10-1), and additional testing would also be introduced in the Inland Waters, representing additional activity compared to the No Action Alternative. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources by activities including in-water devices are expected.

Western Behm Canal, Alaska

There are no testing activities in the Western Behm Canal with the potential for impacts from activities including in-water devices (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the use of in-water devices during testing activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.1.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the number of anti-submarine warfare and mine warfare training activities would increase from the No Action Alternative as described under Alternative 1 (see Table 3.10-1). In-water devices would be deployed in areas currently used for training. Therefore, impacts from training in the Offshore Area would be the same as described in Section 3.10.3.2.1.2 (Alternative 1).

Inland Waters

Under Alternative 2, the Navy proposes to conduct one activity (Maritime Homeland Defense/Security Mine Countermeasures Integrated Exercise, conducted once every year) that would have the potential for impacts from activities including in-water devices as described under Alternative 1 (see Table 3.10-1). In-water devices would be deployed in areas currently used for training but would also be deployed in additional areas. Therefore, impacts from training in the Inland Waters would be the same as described in Section 3.10.3.2.1.2 (Alternative 1).

In accordance with Section 106 of the National Historic Preservation Act, the use of in-water devices during training activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 2, testing activities in the Offshore Area with the potential for impacts from the use of in-water devices would increase from the No Action Alternative (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. Therefore, submerged historic resources would not be affected by testing included in Alternative 2.

Inland Waters

Under Alternative 2, testing involving activities using in-water devices would increase (see Table 3.10-1), and additional testing would also be introduced in the Inland Waters, representing additional activity compared to the No Action Alternative. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts on cultural resources from activities including in-water devices are expected.

Western Behm Canal, Alaska

There are no testing activities under any alternative in the Western Behm Canal with the potential for impacts from activities including in-water devices (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the use of in-water devices during testing activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.2 Impacts from Activities Including Seafloor Devices

Seafloor devices include moored mine shapes, anchors, bottom-placed instruments, and unmanned underwater vehicles that crawl across the ocean floor. Seafloor devices are either stationary or move very slowly along the bottom. Physical disturbances on the continental shelf and seafloor such as precision anchoring, targets or mines resting on the ocean floor, moored mines, bottom-mounted tripods, or autonomous or nonautonomous vehicles could damage or destroy submerged historic resources. Precision anchoring could crush or snag structural elements of historic resources; however, this is highly unlikely. Divers are used to set bottom and moored mine anchors (blocks of concrete weighing several hundred pounds) in waters less than 150 ft. (46 m) deep and routinely avoid known obstructions, which include historic resources and any unrecorded obstructions they might encounter. Seafloor devices could disrupt the horizontal patterning and vertical stratigraphy of submerged historic resources or could damage structural elements of the historic resources through crushing and snagging. However, it is unlikely these resources could be disturbed by the use of seafloor devices because the Navy routinely avoids locations of known obstructions, which includes submerged historic resources.

3.10.3.2.2.1 No Action Alternative

Training Activities

Offshore Area

No training activities using seafloor devices in the Offshore Area are included in the No Action Alternative (see Table 3.10-1). Therefore, submerged historic resources would not be affected by training activities in the No Action Alternative.

Inland Waters

Under the No Action Alternative, training activities using seafloor devices would continue at current levels (see Table 3.10-1). With the exception of precision anchoring exercises, the Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). With regard to precision anchoring activities, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from activities including seafloor devices are expected.

In accordance with Section 106 of the National Historic Preservation Act, the use of seafloor devices during training activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under the No Action Alternative, testing activities using seafloor devices would continue at current levels (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from activities including seafloor devices are expected.

Inland Waters

Under the No Action Alternative, testing activities using seafloor devices would continue at current levels (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities

and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from activities including seafloor devices are expected.

Western Behm Canal, Alaska

No testing activities including or requiring the installation of additional seafloor devices in the Western Behm Canal would occur under any alternative (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the use of seafloor devices during testing activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.2.2 Alternative 1

Training Activities

Offshore Area

No training activities using seafloor devices in the Offshore Area are included in Alternative 1 (see Table 3.10-1). Therefore, submerged historic resources would not be affected by training activities in Alternative 1.

Inland Waters

Under Alternative 1, training activities using seafloor devices would increase in the Inland Waters (see Table 3.10-1). With the exception of precision anchoring exercises, the Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). With regard to precision anchoring activities, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from activities including seafloor devices are expected.

In accordance with Section 106 of the National Historic Preservation Act, the use of seafloor devices during training activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 1, testing activities using seafloor devices would increase in the Offshore Area (Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from activities including seafloor devices are expected.

Inland Waters

Under Alternative 1, testing activities using seafloor devices would increase from the No Action Alternative (see Table 3.10-1) and would involve additional testing areas. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no historic properties

affected; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009a). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from activities including seafloor devices are expected.

Western Behm Canal, Alaska

Testing activities including or requiring the installation of seafloor devices would be introduced in the Western Behm Canal (see Table 3.10-1). The Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts from testing activities including seafloor devices are expected.

In accordance with Section 106 of the National Historic Preservation Act, the use of seafloor devices during testing activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.2.3 Alternative 2

Training Activities

Offshore Area

No training activities using seafloor devices in the Offshore Area are included in Alternative 2 (see Table 3.10-1). Therefore, submerged historic resources would not be affected by training activities in Alternative 2.

Inland Waters

Under Alternative 2, training activities using seafloor devices would increase in the Offshore Area as described in Alternative 1 (see Table 3.10-1). Therefore, impacts from training in the Offshore Area would be the same as described in Section 3.10.3.2.2.2 (Alternative 1).

In accordance with Section 106 of the National Historic Preservation Act, the use of seafloor devices during training activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 2, testing activities using seafloor devices would increase in the Offshore Area (see Table 3.10-1). However, impacts from testing activities using seafloor devices in the Offshore Area would be similar as described in Section 3.10.3.2.2.2 (Alternative 1).

Inland Waters

Under Alternative 2, testing activities using seafloor devices would increase from the No Action Alternative (see Table 3.10-1) and would involve additional testing areas. However, impacts from testing activities using seafloor devices in the Inland Waters would be similar as described in Section 3.10.3.2.2.2 (Alternative 1).

Western Behm Canal, Alaska

Under Alternative 2, testing activities including or requiring the installation of seafloor devices would be introduced in the Western Behm Canal as described under Alternative 1 (see Table 3.10-1). The Navy routinely avoids locations of known obstructions, which include submerged historic resources.

Therefore, impacts from testing in the Offshore Area would be the same as described in Section 3.10.3.2.2.2 (Alternative 1).

In accordance with Section 106 of the National Historic Preservation Act, the use of seafloor devices during testing activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.3 Impacts from Military Expended Materials

The deposition of non-explosive practice munitions, sonobuoys, and military expended materials other than ordnance could impact submerged cultural resources through possible sudden impact of resources on the seafloor or the simple settling of military expended materials on top of submerged cultural resources. The likelihood of these materials either impacting or landing on submerged cultural resources is very low because of the size of the Study Area.

Most of the anticipated expended munitions (e.g., large-caliber, non-explosive practice munitions) would be small objects and fragments that would slowly drift to the sea floor after striking the ocean surface. Larger and heavier objects (e.g., targets, bombs, or missiles) could strike the ocean surface with sufficient velocity, but they would slow down as they moved through the water. These larger and heavier objects could affect a submerged cultural resource by creating sediment and artifact displacement. A historic resource could be affected by damaging structural elements and artifacts in the regions with higher cultural resources density.

If expended materials should sink near or on a submerged cultural resource, the expended materials would not affect the historic characteristics of the submerged historic resource that contribute to its eligibility for the National Register. The presence of expended materials on submerged sites would reflect post-depositional processes.

3.10.3.2.3.1 No Action Alternative

Training Activities

Offshore Area

Under the No Action Alternative, training activities would continue at current levels in the Offshore Area (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

Inland Waters

Under the No Action Alternative, training activities associated with mine warfare would continue at current levels in the Inland Waters (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

In accordance with Section 106 of the National Historic Preservation Act, the deposition of military expended materials during training activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under the No Action Alternative, testing activities would continue at current levels within existing OPAREAs in the Offshore Area (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

Inland Waters

Under the No Action Alternative, testing activities would continue at current levels in the Inland Waters (see Table 3.10-1). The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

Western Behm Canal, Alaska

No testing activities resulting in deposition of expended materials on the ocean bottom in the Western Behm Canal would occur (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the deposition of military expended materials during testing activities under the No Action Alternative would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.3.2 Alternative 1

Training Activities

Offshore Area

Under Alternative 1, the number of expended items from training activities associated with anti-submarine and mine warfare would increase from the No Action Alternative within the Offshore Area (see Table 3.10-1). Expended materials could be deposited on the ocean bottom on or near known and previously unidentified submerged historic resources. However, these materials likely would not contact a submerged historic resource. If they sink near this type of cultural resource, the expended materials would not affect the historic characteristics of the submerged historic resource. The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

Inland Waters

Under Alternative 1, the number of expended items from training activities associated with anti-surface and mine warfare would increase from the No Action Alternative in the Inland Waters (see Table 3.10-1) with the introduction of anti-surface warfare and maritime homeland defense activities and an increase in mine warfare activities. These training activities would occur in areas currently used but would also take place in additional areas. Expended materials could be deposited on the ocean bottom on or near known and previously unidentified submerged historic resources. However, these materials likely would not contact a submerged historic resource. If they sink near this type of cultural resource, the expended materials would not affect the historic characteristics of the submerged historic resource. The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

In accordance with Section 106 of the National Historic Preservation Act, the deposition of military expended materials during training activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 1, expended items from testing activities would increase from the No Action Alternative in the Offshore Area (see Table 3.10-1). Expended materials could be deposited on the ocean bottom on or near known and previously unidentified submerged historic resources. However, these materials likely would not contact a submerged historic resource. If they should sink near this type of cultural resource, the expended materials would not affect the historic characteristics of the submerged historic resource. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with this finding (Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

Inland Waters

Under Alternative 1, the number of expended items from testing activities would increase from the No Action Alternative within the Inland Waters (see Table 3.10-1). Expended materials could be deposited on the ocean bottom on or near known and previously unidentified submerged historic resources. However, these materials likely would not contact a submerged historic resource. If they sink near this type of cultural resource, the expended materials would not affect the historic characteristics of the submerged historic resource. The Navy previously analyzed impacts that could result from these activities and concluded that there would be either no historic properties affected or no adverse effects on historic properties; the Washington State Historic Preservation Office concurred with these findings (Whitlam 2009a, Whitlam 2009b). Furthermore, the Navy routinely avoids locations of known obstructions, which include submerged historic resources. As a result, no impacts by military expended materials are expected.

Western Behm Canal, Alaska

No testing activities resulting in deposition of expended materials on the ocean bottom in the Western Behm Canal would occur (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the deposition of military expended materials during testing activities under Alternative 1 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.2.3.3 Alternative 2

Training Activities

Offshore Area

Under Alternative 2, the number of expended items from training activities associated with mine warfare would increase within the Offshore Area from the No Action Alternative as described in Alternative 1 (see Table 3.10-1). These training activities would occur in areas currently used for training. Therefore, impacts from training in the Offshore Area would be the same as described in Section 3.10.3.2.3.2 (Alternative 1).

Inland Waters

Under Alternative 2, the number of expended items from training activities associated with mine warfare would increase from the No Action Alternative within the Inland Waters as described in Alternative 1 (see Table 3.10-1). However, impacts from training in the Inland Waters would be the same as described in Section 3.10.3.2.3.2 (Alternative 1).

In accordance with Section 106 of the National Historic Preservation Act, the deposition of military expended materials during training activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

Testing Activities

Offshore Area

Under Alternative 2, expended items from testing activities would increase from the No Action Alternative within the Offshore Area (see Table 3.10-1). However, impacts from testing in the Offshore Area would be similar as described in Section 3.10.3.2.3.2 (Alternative 1).

Inland Waters

Under Alternative 2, expended items from testing activities within the Inland Waters would increase from the No Action Alternative (see Table 3.10-1). However, impacts from testing in the Inland Waters would be similar as described in Section 3.10.3.2.3.2 (Alternative 1).

Western Behm Canal, Alaska

No testing activities resulting in deposition of expended materials on the ocean bottom in the Western Behm Canal would occur (see Table 3.10-1). Therefore, submerged historic resources would not be affected by testing activities.

In accordance with Section 106 of the National Historic Preservation Act, the deposition of military expended materials during testing activities under Alternative 2 would not adversely affect submerged historic resources within U.S. territorial waters.

3.10.3.3 Summary of Potential Impacts of All Stressors on Cultural Resources

Stressors described in this EIS/OEIS would not result in potential impacts on cultural resources under the No Action Alternative, Alternative 1, or Alternative 2 within U.S. territorial waters because measures discussed in 3.10.2.4 have been previously implemented to protect these resources. In addition, impacts that could result from the stressors associated with the training and testing activities and geographic areas included in this document have been addressed in previous compliance submittals to state and tribal agencies, who concurred with this finding. Accordingly, the Navy does not intend to consult with the Alaska, Washington, Oregon, or California State Historic Preservation Offices. Consultation could be required in the future under Section 106 of the NHPA, however, to resolve any adverse effects on cultural resources anticipated to occur within state territorial waters (within 3 nm).

Table 3.10-2 discusses the Section 106 effects applicable to cultural resources resulting from the training and testing activities that would occur under the proposed alternatives.

Table 3.10-2: Summary of Section 106 Effects of Training and Testing Activities on Cultural Resources

Alternative and Stressor	Section 106 Effects of Training and Testing Activities
No Action Alternative	
Acoustic Stressors	Acoustic stressors resulting from underwater explosions creating shock (pressure) waves and cratering of the seafloor during training and testing activities would not adversely affect submerged historic resources within United States (U.S.) territorial waters because measures have been previously implemented to protect these resources.
Physical Stressors	Physical stressors resulting from vessel strikes and use of in-water devices, use of seafloor devices, or deposition of expended materials would not adversely affect submerged historic resources within U.S. territorial waters.
Alternative 1 (Preferred Alternative)	
Acoustic Stressors	Acoustic stressors resulting from underwater explosions creating shock (pressure) waves and cratering of the seafloor during training and testing activities would not adversely affect submerged historic resources within U.S. territorial waters because measures have been previously implemented to protect these resources.
Physical Stressors	Physical stressors resulting from vessel strikes and use of in-water devices, use of seafloor devices, and deposition of expended materials during training and testing activities would not adversely affect submerged historic resources within U.S. territorial waters because measures have been previously implemented to protect these resources.
Regulatory Determination	Alternative 1 increases the number of training and testing activities and introduces these activities in additional areas. Acoustic and physical stressors, as indicated above, would not adversely affect submerged historic resources within U.S. territorial waters in accordance with Section 106 of the National Historic Preservation Act (NHPA). The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties. The Washington State Historic Preservation Office concurred with these findings. In accordance with Section 402 of the NHPA, no World Heritage sites would be affected.
Alternative 2	
Acoustic Stressors	Acoustic stressors resulting from underwater explosions creating shock (pressure) waves and cratering of the seafloor during training and testing activities would not adversely affect submerged historic resources within U.S. territorial waters because measures have been previously implemented to protect these resources.
Physical Stressors	Physical stressors resulting from vessel strikes and use of in-water devices, use of seafloor devices, and deposition of expended materials during training and testing activities would not adversely affect submerged historic resources within U.S. territorial waters because measures have been previously implemented to protect these resources.
Regulatory Determination	Alternative 2 increases the number of training and testing activities, and introduces these activities in additional areas. Acoustic and physical stressors, as indicated above, would not adversely affect submerged historic resources within U.S. territorial waters in accordance with Section 106 of the NHPA. The Navy previously analyzed impacts that could result from these activities and concluded that there would be no adverse effects on historic properties. The Washington State Historic Preservation Office concurred with these findings. In accordance with Section 402 of the NHPA, no World Heritage sites would be affected.

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3.11 Native American and Alaska Native Traditional Resources

TABLE OF CONTENTS

3.11 NATIVE AMERICAN AND ALASKA NATIVE TRADITIONAL RESOURCES 3.11-1
3.11.1 INTRODUCTION AND METHODS 3.11-1
3.11.1.1 Introduction 3.11-1
3.11.1.2 Identification, Evaluation, and Treatment of Traditional Resources 3.11-2
3.11.1.3 Fishing Rights 3.11-3
3.11.1.4 Methods 3.11-5
3.11.2 AFFECTED ENVIRONMENT 3.11-15
3.11.2.1 Native American Resources Eligible for or Listed on the National Register of Historic Places 3.11-15
3.11.2.2 Native American Resources Eligible for or Listed on State Registers 3.11-15
3.11.2.3 Treaty Fishing Areas and Subsistence Use 3.11-15
3.11.2.4 Current Practices 3.11-17
3.11.3 ENVIRONMENTAL CONSEQUENCES 3.11-18
3.11.3.1 Accessibility 3.11-20
3.11.3.2 Airborne Acoustics 3.11-28
3.11.3.3 Physical Disturbance and Strike Stressors 3.11-28
3.11.3.4 Secondary Impacts 3.11-37
3.11.3.5 Summary of Potential Impacts of All Stressors on Native American and Alaska Native Traditional Resources 3.11-38

LIST OF TABLES

TABLE 3.11-1: STRESSORS APPLICABLE TO NATIVE AMERICAN AND ALASKA NATIVE TRADITIONAL RESOURCES FOR TRAINING AND TESTING ACTIVITIES 3.11-20
TABLE 3.11-2: SUMMARY OF EFFECTS OF TRAINING AND TESTING ACTIVITIES ON NATIVE AMERICAN AND ALASKA NATIVE TRADITIONAL RESOURCES 3.11-38

LIST OF FIGURES

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3.11 Native American and Alaska Native Traditional Resources

NATIVE AMERICAN AND ALASKA NATIVE TRADITIONAL RESOURCES SYNOPSIS

The United States Department of the Navy considered all potential stressors and analyzed the following for Native American and Alaska Native traditional resources:

- Accessibility (limiting access to the ocean)
- Airborne Acoustics
- Physical Disturbance and Strike Stressors (activities using seafloor devices and deposition of military expended materials)
- Secondary Impacts (from changes to the availability of marine resources)

Preferred Alternative (Alternative 1)

- Impacts on Native American and Alaska Native protected tribal resources and other traditional resources would not occur because inaccessibility to areas of co-use would be temporary, use of seafloor devices could create damage or loss to Native American fishing equipment but would not affect the use of the usual and accustomed fishing grounds, and marine species' population levels would not be altered to such an extent that tribes could no longer find their target species.

3.11.1 Introduction and Methods

3.11.1.1 Introduction

Native American and Alaska Native traditional resources are found throughout the Northwest Training and Testing (NWTT) Study Area (hereafter referred to as the Study Area). The approach to assessing these resources includes consulting with tribal governments to identify resources; defining the resource; presenting the regulatory requirements for identifying, evaluating, and treating the resource within established jurisdictional parameters; establishing the specific resource subtypes in the Study Area; identifying the data used to define the current conditions; and describing the method of impact analysis.

Native American and Alaska Native traditional resources are resources associated with beliefs or cultural practices of a living culture, subculture, or community. These beliefs and practices must be rooted in the group's history and must be important in maintaining the cultural identity of the group. Traditional uses may prescribe the use of particular native plants, animals, or minerals from specific places. The community may consider these resources essential for the continuation of their traditional culture.

Protected tribal resources, as defined in Department of Defense (DoD) Instruction 4710.02, *DoD Interactions with Federally Recognized Tribes*, are "those natural resources and properties of traditional or customary religious or cultural importance, either on or off Indian lands, retained by or reserved by or for Indian tribes through treaties, statutes, judicial decisions, or executive orders, including tribal trust resources." This section also addresses Native American and Alaska Native protected tribal resources and other traditional resources that are retained or reserved by or for Native American and Alaska Native Tribes through treaties. These resources include plants, animals, and locations associated with hunting, fishing, and gathering activities for subsistence or ceremonial use.

3.11.1.2 Identification, Evaluation, and Treatment of Traditional Resources

To summarize, the Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, including the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. The area includes air and water space within Washington, as well as outside state waters of Oregon and Northern California. It includes four existing range complexes and facilities: the Northwest Training Range Complex (NWTRC); the Naval Undersea Warfare Center (NUWC) Division, Keyport; Carr Inlet Operating Area (OPAREA); and the Southeast Alaska Acoustic Measurement Facility (SEAFAC). In addition to these range complexes, the Study Area also includes United States (U.S.) Department of the Navy (Navy) pierside locations where sonar (sound navigation and ranging) maintenance and testing occurs as part of overhaul, modernization, maintenance and repair activities at Navy piers at Naval Base (NAVBASE) Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett.

Procedures for identifying, evaluating, and treating Native American and Alaska Native traditional resources, within state territorial waters (0–3 nautical miles [nm] of the coast) and U.S. territorial waters (0–12 nm of the coast) are contained in a series of federal and state laws and regulations, as well as in agency guidelines. Traditional resources along with archaeological and architectural resources are protected by various laws and their implementing regulations: the National Historic Preservation Act of 1966 as amended in 2006, the American Indian Religious Freedom Act of 1978, and the Native American Graves Protection and Repatriation Act of 1990. The Advisory Council on Historic Preservation (Advisory Council) further guides treatment of cultural resources through the regulations *Protection of Historic Properties* (36 Code of Federal Regulations [C.F.R.] Part 800). The category of "historic properties" is a subset of cultural resources defined in the National Historic Preservation Act (16 U.S. Code [U.S.C.] § 470w(5)) as any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion on, the National Register of Historic Places, including artifacts, records, and material remains related to such a property or resource. Traditional resources may also be listed in or eligible for listing in the National Register of Historic Places.

Scoping letters for this Environmental Impact Statement (EIS)/Overseas EIS (OEIS) were sent on 23 February 2012, to the following Native American and Alaska Native Tribes: Chinook Indian Nation, Confederated Tribes of the Chehalis Reservation, Cowlitz Indian Tribe, Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Lummi Tribe, Makah Tribe, Muckleshoot Indian Tribe, Nisqually Indian Tribe, Nooksack Indian Tribe, Port Gamble S'Klallam Tribe, Puyallup Tribe, Quileute Tribe, Quinault Nation, Samish Indian Tribe, Sauk-Suiattle Indian Tribe, Shoalwater Bay Tribe, Skokomish Tribal Nation, Snoqualmie Tribe, Squaxin Island Tribe, Stillaguamish Tribe, Suquamish Tribe, Swinomish Tribe, Tulalip Tribe, Upper Skagit Tribe, Confederated Tribes of Coos, Lower Umpqua, and Suislaw Indians, Confederated Tribes of Grand Ronde Community of Oregon, Confederated Tribes of Siletz Indians, Confederated Tribes of the Warm Springs Reservation, Coquille Indian Tribe, Cow Creek Band of Umpqua Indians, Klamath Tribes, Cahto Indian Tribe of the Laytonville Rancheria, Cher-Ae Heights Indian Community of the Trinidad Rancheria, Coyote Valley Band of Pomo Indians, Elk Valley Rancheria, Hoopa Valley Tribe, Hopland Band of Pomo Indians of the Hopland Rancheria, Karuk Tribe, Pinoleville Pomo Nation, Potter Valley Tribe, Redwood Rancheria of Pomo Indians, Robinson Rancheria of Pomo Indians, Round Valley Indian Tribes, Scotts Valley Band of Pomo Indians, Sherwood Valley Rancheria of Pomo Indians, Smith River Rancheria, Tolowa Nation, Wiyot Tribe, Yurok Tribe, Central Council of the Tlingit and Haida Indian Tribes, Ketchikan Indian Community, Metlakatla Indian Community, and Organized Village of Saxman. Scoping letters dated 23 February 2012, were also sent to the Northwestern Indian Fisheries Commission, Skagit River System Cooperative, the InterTribal Sinkyone Wilderness Council, Cape Fox Corporation, and Sealaska.

In January 2014, Commanding Officers of Naval Air Station Whidbey Island and Naval Base Kitsap invited Native American and Alaska Native Tribes with traditional resources in the Study Area to consider the Navy's draft analysis and finding that the Proposed Action does not have the potential to significantly affect protected tribal resources. The Navy invited the Tribes to initiate government-to-government consultation or hold staff level consultations if in disagreement with the Navy's finding. Consultations with the Tribes are anticipated to occur throughout the January to December 2014 time frame.

3.11.1.3 Fishing Rights

Native American and Alaska Native Tribes are dependent sovereign nations. Accordingly, the United States has a trust relationship with Native American and Alaska Native Tribes. The DoD American Indian and Alaska Native Policy states: "Under the federal trust doctrine, the United States—and individual agencies of the federal government—owe a fiduciary duty to Indian tribes. The nature of that duty depends on the underlying substantive laws (i.e., treaties, statutes, agreements) creating the duty. Where agency actions may affect Indian lands or off-reservation treaty rights, the trust duty includes a substantive duty to protect these lands and treaty rights 'to the fullest extent possible.' Otherwise, unless the law imposes a specific duty on the federal government with respect to Indians, the trust responsibility may be discharged by the agency's compliance with general statutes and regulations not specifically aimed at protecting Indian tribes." The trust responsibility has been interpreted to require federal agencies to carry out their activities in a manner that is protective of Native American and Alaska Native treaty rights. Executive Order (EO) 13175, *Consultation and Coordination with Indian Tribal Governments,* affirms the trust responsibility of the United States and directs agencies to consult with Native American and Alaska Native Tribes and to respect tribal sovereignty when taking actions affecting such rights.

Treaties with Native American and Alaska Native Tribes are government-to-government agreements, similar to international treaties, and preempt contrary state laws. Tribal treaty rights are not affected by later federal laws (unless Congress clearly abrogates treaty rights). Treaty language securing fishing and hunting rights is not a "grant of rights (from the federal government to the Indians), but a grant of rights from them—a reservation of those not granted" (United States v. Winans, 25 S. Ct. 662 (1905)). This means that the Native American and Alaska Native Tribes retain rights not specifically surrendered to the United States. Furthermore, the United States has a trust or special relationship with Native American and Alaska Native Tribes. In 1855, the Suquamish Tribe and several other tribes negotiated a treaty that created reservations, including the Port Madison Indian Reservation across Liberty Bay from NUWC Division Keyport. Also in 1855, the Confederated Tribes and Bands of the Yakama Nation ceded to the United States over 12 million acres of land in what is now central Washington (U.S. Government 1855). This treaty established a reservation and ensured fishing rights at all usual and accustomed places.

3.11.1.3.1 Off Reservation Treaty Fishing Rights

Between 1854 and 1856, the United States negotiated five treaties—the treaties of Medicine Creek, Quinault, Neah Bay, Point Elliot, and Point No Point—with the northwest tribes to acquire great expanses of land (U.S. District Court 1974). These treaties guaranteed tribes fishing rights in common with citizens of the territory. As a result, reservations were established, including the Sauk-Suiattle Indian Tribe, Swinomish Indians, and Jamestown S'Klallam at Port Gamble. The treaties collectively are called the Stevens-Palmer Treaties, after Isaac I. Stevens, the governor of the Washington Territory, and Joel Palmer, the superintendent of Indian affairs for the Oregon Territory, who negotiated the treaties on behalf of the United States (Woods 2005). These federal treaties ensured tribes living in western

Washington the right to fish at "usual and accustomed grounds and stations." In 1855, the Suquamish Tribe and several other tribes negotiated a treaty that created reservations, including the Port Madison Indian Reservation across Liberty Bay from NUWC Division Keyport. Also in 1855, the Confederated Tribes and Bands of the Yakama Nation ceded to the United States over 12 million acres of land in what is now central Washington (U.S. Government 1855). This treaty established a reservation and ensured fishing rights at all usual and accustomed places.

On 12 February 1974 Judge George H. Boldt issued a landmark federal court decision, now known as the Boldt decision. This decision recognized that 14 western Washington Native American tribes and nations had, in their original treaties, retained for themselves, access to "usual and accustomed fishing grounds and stations." The case area was "that portion of the State of Washington west of the Cascade Mountains and north of the Columbia River drainage area, and included the American portion of the Puget Sound watershed, the watersheds of the Olympic Peninsula north of the Grays Harbor watershed, and the offshore waters adjacent to those areas" (Boldt 1974).

As a result of the Boldt decision, the court determined that tribal treaty rights include: a right of access to usual and accustomed fishing grounds and stations and a right of up to 50 percent of the fin and shellfish that pass through or are present in a tribe's usual and accustomed fishing grounds and stations. Most recently the court determined in the "culverts litigation" that tribal treaty rights include habitat protection; however, the court's decision has been appealed.

Some of the principles established by the court decisions have been applied to other resources, including shellfish. In 1994, the courts ruled that the treaty tribes had also retained the right to harvest half of the shellfish in the treaty areas, commonly known as the Rafeedie decision. The Skokomish Indian Tribe and the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam tribes have fully participated in the commercial geoduck clam fishery since 1995. Presently, the tribes partner with personnel from the Washington Department of Fish and Wildlife to manage fishery resources and to protect and enhance the salmon, shellfish, and hunting resources. Salmon are a primary resource for the treaty tribes; salmon are "treated ceremoniously by providing a core symbol of tribal identity, individual identity, and the ability of the Indian culture to endure as well as being of nutritional and economic importance" (U.S. Department of the Navy 2006).

Subpart 50 C.F.R. 660.701 implements the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species. These regulations govern commercial and recreational fishing for highly migratory species in the U.S. economic environmental zones off the coasts of Washington, Oregon, and California and in adjacent high seas waters. The Pacific Coast Treaty Indian Rights (50 C.F.R. 660.706) provides treaty rights to the Makah, Quileute, and Hoh tribes and to the Quinault Indian Nation to harvest highly migratory species in their usual and accustomed fishing areas in U.S. waters (National Oceanic and Atmospheric Administration and U.S. Department of Commerce 2011).

3.11.1.3.2 Western Behm Canal, Alaska Fishing Rights

The Alaska Statehood Act of 1958 stipulated that the United States holds and retains absolute jurisdiction and control of any lands or other property (including fishing rights), the right or title to which may be held by Alaska Native tribe, Eskimo, or Aleut populations or is held by the United States in trust for said groups (Jones 1981).

On December 18, 1971, after a lengthy history indicating that Alaska Native people had aboriginal claims to ancestral lands and resources, , Alaska Native aboriginal claims were "settled" and extinguished by an

Act of Congress and signed by President Nixon through the Alaska Native Claims Settlement Act (ANCSA), the largest land claims settlement in U.S. history. Rather than designating reservations held in trust by the U.S. Government, as the majority of tribes in the Lower 48 states have, the Alaska Native Claims Settlement Act created 12 regional profit-making Alaska Native corporations and over 200 village, group, and urban corporations to receive approximately 45.5 million acres of land along with a cash payment of approximately $1 billion. A 13th regional corporation headquartered in Seattle was later established for Alaska Natives who live outside of Alaska who participated in the cash settlement but did not receive land. ANCSA terminated all Indian reservations and reserves in Alaska with the exception of Metlakatla. Tribes that had their reservations terminated had the option of keeping their former reservation land with both surface and subsurface ownership. If they chose that option, they did not receive a cash settlement or participate as shareholders in the regional corporations. ANCSA extinguished aboriginal claims to land and any aboriginal hunting and fishing rights that may have existed. Section 17(d)(1 and 2) of ANCSA provided for withdrawing millions of acres of unreserved public land in Alaska for national and public interests, which resulted in the passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980. ANILCA protected over 100 million acres of federal lands in Alaska, doubling the size of the country's national park and refuge system and tripling the amount of land designated as wilderness. ANILCA also addressed issues of Alaska Native land claims, the subsistence lifestyle, energy development, economic growth, and transportation planning by creating solutions that were meant to be compatible with each other. As defined in Title VIII, Section 803, subsistence uses are, "the customary and traditional uses by rural Alaska residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.''

Subsistence hunting and fishing are economically and culturally important for many Alaskans. Alaska state law directs the Board of Game and Board of Fisheries to provide a reasonable opportunity for subsistence uses first, before providing for other uses of any harvestable surplus of a fish or game population. State law also requires identification of nonsubsistence areas, which are defined as areas where dependence upon subsistence (customary and traditional uses of fish and wildlife) is not a principal characteristic of the economy, culture, and way of life.

Though a relatively small part of the overall state economy, salmon fishing is the mainstay of several Native American villages as well as for segments of the population residing in many shoreline cities and towns. Salmon is an important source of spiritual and physical sustenance for Northwest and Alaskan Native American tribes, and salmon are culturally important to many other residents of these areas. Subsistence and recreational fishermen use a variety of fishing gear to harvest salmon (National Oceanic and Atmospheric Administration 2012).

3.11.1.4 Methods

3.11.1.4.1 Approach

For compliance with Section 106 of the National Historic Preservation Act, the area of potential effects is considered the same as the Study Area defined in Section 2.1 of this document. The Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, to include the Strait of Juan de Fuca, Puget Sound, and Western Behm Canal in southeastern Alaska. Within the Pacific region, the approach for establishing current conditions is based on different regulatory parameters defined by geographic location. Within state territorial waters (0–3 nm), the

National Historic Preservation Act is the guiding mandate; within U.S. territorial waters (0–12 nm), the National Environmental Policy Act (NEPA) is the primary mandate. Areas beyond 12 nm in the open ocean are beyond the jurisdiction of NEPA. Usual and accustomed fishing areas for four federally recognized tribes (Hoh Tribe, Makah Indian Tribe, Quileute Tribe, and Quinault Indian Nation) extend beyond 12 nm and will be considered here.

Protected tribal resources and other traditional resources are defined through treaty rights with specific locations and materials identified through consultation with Native American and Alaska Native Tribes. Factors considered when determining if an alternative could have a significant impact on Native American or Alaska Native traditional resources includes whether and to what degree the resource would be affected and whether access by tribal members to the resource would change. Government-to-government consultation will be conducted with potentially affected federally recognized Native American and Alaska Native Tribes to identify affected protected tribal resources and other traditional resources, evaluate the extent of any adverse effects, determine the significance of impacts, and develop mitigation measures, if necessary.

3.11.1.4.2 Data Sources

Cultural resources information relevant to this EIS/OEIS was derived from a variety of sources, including previous environmental documents, online information repositories associated with State Historic Preservation Offices, online maps and data, and published sources, as cited.

3.11.1.4.2.1 Previous Environmental Documents

Previous environmental documents used for general information include the *Marine Resources Assessment for the Pacific Northwest Operating Area* (U.S. Department of the Navy 2006), the *Northwest Training Range Complex EIS/OEIS* (U.S. Department of the Navy 2010a), the *NAVSEA NUWC Keyport Range Complex Extension EIS/OEIS* (U.S. Department of the Navy 2010b), and the *Trident Support Facilities Explosive Handling Wharf (EHW-2) Final EIS* (U.S. Department of the Navy 2012). Additional sources included the *Handbook of North American Indians, Volume 7, Northwest* (Suttles 1990) and *Volume 8, California* (Heizer 1978); *Tiller's Guide to Indian Country: Economic Profiles of American Indian Reservations* (Tiller 2005a); and the *Tribal Leaders Directory Spring 2011* (Bureau of Indian Affairs 2011).

3.11.1.4.2.2 National Register Information System

The online National Register Information System was reviewed to identify National Register of Historic Places-listed properties, historic districts, and National Historic Landmarks. Appropriate information from repositories associated with the State Historic Preservation Offices was obtained or their online databases were reviewed for information on traditional resources, types, and eligibility for listing on the National Register of Historic Places.

3.11.1.4.2.3 Previous Coordination with Native American and Alaska Native Tribes

In September 2003, the Navy sent scoping letters to associated Native American tribes regarding the NUWC Keyport Range Complex Extension EIS/OEIS and invited the tribes to government-to-government consultation. Government-to-government was requested by the Hoh Tribe, Jamestown S'Klallam, Lower Elwha Klallam Tribe, Port Gamble S'Klallam, Quileute Tribe, Quinault Nation and Suquamish Tribe. The Navy solicited feedback on the Draft EIS/OEIS in September 2008, and government-to-government consultations occurred as part of Section 106 compliance for the NUWC Keyport Range Complex Extension EIS/OEIS between October 2008 and March 2009. The Navy presented the Proposed Action

and Alternatives of the EIS/OEIS and initiated government-to-government consultations with (listed in alphabetical order): Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Makah Tribe, Port Gamble S'Klallam Tribe, Quileute Tribe, Quinault Nation, Skokomish Indian Tribe, and Suquamish Tribe. Additionally, the Point No Point Treaty Council was notified. Some of the main concerns of the Native American Indian tribes and nations included potential restricted access to beach areas and usual and accustomed fishing (e.g., shellfish) grounds, potential damage to fishing gear, and effects on returning salmon in the streams. The Navy responded to these comments in Appendix G of the Final EIS/OEIS and made appropriate changes to the EIS/OEIS based on the comments received.

In July 2007, the Navy sent scoping letters inviting involvement of associated Native American tribes in public participation efforts associated with the NWTRC EIS/OEIS. Comments were also solicited during public review of the Draft EIS/OEIS from December 2009 to April 2010. In fulfillment of Section 106 obligations for completion of the EIS/OEIS, the Navy considered comments from Native American tribes resulting from communications during the NEPA process. The following Washington tribes were invited to participate in government-to-government consultation (listed in alphabetical order): Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, Lummi Tribe, Makah Tribe, Nisqually, Nooksack, Northwestern Indian Fisheries Commission, Point No Point Treaty Council, Port Gamble S'Klallam Tribe, Puyallup, Quileute Tribe, Quinault Nation, Sauk-Suiattle, Skokomish Tribal Nation, Squaxin Island, Stillaguamish, Suquamish Tribe, Swinomish Tribe, Tulalip Tribe, and Upper Skagit Tribe. The following Oregon and California tribes were also invited to participate in government-to-government consultations (listed in alphabetical order): Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians; Confederated Tribes of Grande Ronde; Confederated Tribes of Siletz; Confederated Tribes of the Umatilla Indian Reservation; Confederated Tribes of the Warm Springs Reservation; Coquille Tribe; Cow Creek Band of Umpqua Tribe; Klamath Tribes (Klamath, Modoc, Yahooskin); Tolowa Nation/Trinidad Rancheria; Upper Shoal Water Tribe; and Yurok Indian Reservation. No government-to-government consultation was requested, and all communication with the Navy was conducted through tribal staff. Comments related to several topics of concern, including impacts on usual and accustomed fishing rights, communication protocols between the Navy and tribes, and safety of tribal fishing vessels, were provided by the tribes. The Navy responded to these comments in Appendix G of the Final EIS/OEIS and made appropriate changes to the EIS/OEIS based on the comments received.

In 1997, a cooperative agreement was signed between the Navy and the Skokomish Tribal Nation, the Port Gamble S'Klallam Tribe, the Lower Elwha Klallam Tribe, and the Jamestown S'Klallam Tribe. The parties agreed that during the term of the agreement the tribes would harvest intertidal shellfish at one beach at NAVBASE Kitsap at Bangor. Tribes continue to harvest shellfish at the beach south of Delta Pier, and this beach has been identified as an area of traditional tribal resource use. The species composition and timing of the tribal shellfish harvest is governed by the Point No Point Treaty Council, which develops "annual shellfish management plans for each species and geographic region within the usual and accustomed fishing area of the PNPTC tribes. These plans are developed jointly with the state of Washington" (Point No Point Treaty Council 2010).

In 1998, a memorandum of agreement was signed between the Navy and the Tulalip Tribes of Washington as a result of Homeport-related construction activities and subsequent Navy operations at Naval Station Everett. The agreement included monetary compensation for the loss of access to fishing grounds within a 45-acre area and displacement from fishing grounds (and loss of fish harvest) by Navy activity outside the 45 acres, access to project data and ability to implement tribal monitoring and impacts studies, and further consultation to establish procedures and elements for Navy fish and water quality monitoring and studies.

3.11.1.4.3 Cultural Context

Several types of historic properties are present in the Study Area, including Native American and Alaska Native marine resource gathering areas (e.g., traditional fishing areas; whaling areas; and seaweed-, mussel-, abalone-, and clam-gathering grounds). The context within which these types of resources were formed provides an understanding of the overall development of the resource base and information on relative locations.

3.11.1.4.3.1 Offshore Area

Eighteen federally recognized Pacific Coast Native American tribes are currently or historically associated with the Offshore Area. The following federally recognized Washington tribes have usual and accustomed fishing rights in areas where the Navy conducts training and testing in the Offshore Area:

- Hoh Tribe, Washington State
- Makah Indian Tribe, Washington State
- Quileute Tribe, Washington State
- Quinault Indian Nation, Washington State

The Hoh Tribe is a band of the Quileute Tribe, although it is recognized as a separate tribal entity. Their reservation is on the Olympic Peninsula of northern Washington. The tribe retains many of its traditional customs, including practicing the canoe culture. Members dip net for smelt and harvest perch, crab, and razor and butter clams from tidelands, and they operate a fish hatchery program (Tiller 2005p).

The Makah Indian Tribe reservation on the northwestern tip of the Olympic Peninsula was established by the Treaty of Neah Bay in 1855 (Tiller 2005t). The Makah Indian Tribe, of Nooktan origin, practiced a subsistence lifestyle centered on fishing for sea otters, whale, seal, and smaller species such as shellfish, and on trading these products with other tribes (Tiller 2005t). Currently, although tribal income is broadly based on agriculture, livestock, forestry, construction, services and retail, transportation, and tourism and recreation, the “fishing industry represents the most important aspect of the Makah’s economy” (Tiller 2005t). In 1998, approximately 70 percent of the tribal population was engaged in employment in fishing for salmon, groundfish, and sea urchins, while others were employed in a fish-buying and processing plant. The Makah Nation Fish Hatchery is designed for public viewing of migrating salmon.

Quileute Tribe culture is centered on the ocean, river, and forest, and the Quileute are linguistically related to the Hoh. The Quileute Reservation is along Pacific Ocean beaches at the mouth of the Quileute River. They historically practiced a hunting, fishing, and gathering subsistence lifestyle, dominated by the use of seal and whale oil, which also was used as a valuable trading commodity (Tiller 2005aa). Many present-day Quileute derive their livelihood from tourism, small commercial development, logging, and fishing industries.

The Quinault Indian Nation (“canoe people” or “people of the cedar tree”) originally practiced a subsistence lifestyle centered on fishing, hunting, and gathering. Their reservation is in the southwestern corner of the Olympic Peninsula (Tiller 2005ab). The Quinault economy is based on gaming, tourism, media and communications, small commercial development, logging, and fishing industries.

These four Washington coastal tribes helped support designation and ongoing operation of the Olympic Coast National Marine Sanctuary, are members of the Sanctuary Advisory Council, and help shape policy, education, and research (National Oceanic and Atmospheric Administration 2008). In addition to being members of the Olympic Coast National Marine Sanctuary Advisory Council, the four coastal

tribes, with the State of Washington, have formed the Olympic Coast National Marine Sanctuary Intergovernmental Policy Council to better coordinate the needs and rights of the co-managers of the resources within the sanctuary with sanctuary staff and the National Marine Sanctuary Program.

The following Washington, Oregon, and California federally recognized tribes may conduct activities in areas where the Navy conducts training and testing in the Offshore Area. The tribes are as follows:

- Confederated Tribes of the Chehalis Reservation
- Cowlitz Indian Tribe, Washington State
- Shoalwater Bay Indian Tribe, Washington State
- Confederated Tribes of Coos, Lower Umpqua, and Suislaw Indians, Oregon
- Confederated Tribes of Grand Ronde Community of Oregon, Oregon
- Confederated Tribes of Siletz Indians of Oregon, Oregon
- Coquille Indian Tribe of Oregon, Oregon
- Big Lagoon Rancheria, California
- Cher-Ae Heights Indian Community of the Trinidad Rancheria, California
- Elk Valley Rancheria, California
- Resighini Rancheria, California
- Smith River Rancheria, California
- Wiyot Tribe (formerly the Table Bluff Rancheria), California
- Yurok Tribe, California

The Confederated Tribes of the Chehalis Reservation is located near the confluence of the Black and Chehalis rivers south of Puget Sound and consist of the Upper Chehalis and Lower Chehalis tribes. Historically, the Upper Chehalis subsistence was a riverine based economy; the Lower Chehalis subsistence was ocean based. Historically, subsistence was based on fishing for salmon (chinook, chum, and coho) on the Chehalis River, fishing for summer sturgeon in Willapa Bay, collecting shellfish, coastal fishing for halibut, cod, surf smelt, and herring, hunting seals, porpoises, sea lions, and sea otters, hunting elk, deer, and bear in the uplands, and gathering camas, berries, and other plant foods (Hajda 1990). Subsistence and ceremonial fishing are still vital to the tribal culture and the present economy includes livestock raising, small commercial salmon fishing, and gaming (Tiller 2005al).

The Cowlitz Indian Tribe are a part of the southwest coast Salish (including the Quinault, Lower Chehalis, and Upper Chehalis groups), with traditional territory inland along the Cowlitz River, a tributary of the Columbia River. Historically, subsistence was based on fishing for salmon (coho, chum, and fall Chinook) and eulachon on the Cowlitz River, hunting elk and deer in the uplands, and gathering camas, berries, hazelnuts and other plant foods. Currently, the Cowlitz Indian Tribe continues traditional activities including fishing and is pursuing the establishment of reservations lands and building a casino (Hajda 1990; Tiller 2005ak).

The Shoalwater Bay Indian Tribe resides on Willapa Bay at North Cove on the coast of Washington. The population are members of the Chehalis, Chinook, and Quinault Tribes. Traditional subsistence was based on salmon, sturgeon, halibut, cod, surf smelt, herring, trout, shellfish, stranded whales, sea mammals (such as seals, porpoises, sea lions, and sea otters), deer and elk (Hajda 1990). Currently, the economy is based on small commercial development and gaming (Tiller 2005ad).

The Confederated Tribes of Coos, Lower Umpqua, and Suislaw Indians, Oregon live on Coos Bay in southwestern Oregon, and the population are members of the Coos, Lower Umpqua, and Siuslaw Tribes.

Traditional subsistence was based on salmon, herring, smelt, lampreys, saltwater and freshwater fish, shellfish, seals, sea lions, deer, and elk (Zenk 1990). Their current economy is based on tourism and gaming (Tiller 2005l).

The Confederated Tribes of Grand Ronde Community of Oregon reside in the Willamette Valley in northwestern Oregon, and the population are members of the Kalapuya, Clackamas, Molalla, Rogue River, Chasta, Umpqua, Salmon River, and Nehalem bands of the Tillamook Tribes. Traditionally subsistence was based on salmon, lamprey eel, stranded whales, sea lions, seals, shellfish, and elk (Seaburg and Miller 1990). Presently, the economy is based on forestry, mining, commercial development, communications, tourism, and gaming (Tiller 2005n).

The Confederated Tribes of Siletz Indians of Oregon live near Siletz in western Oregon, and the population are members of the Kalapuya, Molalla, Rogue River, Chasta, Umpqua, Calapooia, and Scoton Tribes. Traditionally, subsistence was based on salmon, lamprey eel, stranded whales, sea lions, seals, shellfish, and elk (Seaburg and Miller 1990). Currently, the economy is based on forestry, fisheries, manufacturing, commercial development, communications, tourism and gaming (Tiller 2005o).

The Coquille Indian Tribe of Oregon resides near Coos Bay and North Bend, Oregon, and the population are members of the Coquille Indian Tribe. Traditional subsistence was based on salmon, shellfish, camas root, acorns, roots and berries, deer, and elk (Miller and Seaburg 1990). The current economy is based on agriculture, construction, tourism, and gaming (Tiller 2005m).

The Big Lagoon Rancheria live in northern California, and the population are members of the Tolowa and Yurok Tribes. Traditional Tolowa subsistence was seasonally based and focused on fishing for salmon and smelt, hunting, acorn collecting, and plant gathering (Gould 1978); Yurok subsistence included harvesting shellfish; fishing for salmon, sturgeon, eel, candlefish, and surffish; hunting deer, elk, and sea lion; and collecting acorns (Pilling 1978). Current practices include fishing and shellfishing (Tiller 2005e). The present economy is based on tourism.

The Elk Valley Rancheria reside in northern California, and the population are members of the Tolowa, Yurok, and Kuroki Tribes (Tiller 2005f). Traditional Tolowa subsistence was seasonally based and focused on fishing for salmon and smelt, hunting, acorn collecting, and plant gathering (Gould 1978); Yurok subsistence included harvesting shellfish; fishing for salmon, sturgeon, eel, candlefish, and surffish; hunting deer, elk, and sea lion; and collecting acorns (Pilling 1978). The current economy is based on small commercial development and gaming (Tiller 2005f).

The Resighini Rancheria live in northern California on the south shore of the Klamath River, and the population are members of the Yurok Tribe (Tiller 2005g). Yurok subsistence included harvesting shellfish; fishing for salmon, sturgeon, eel, candlefish, and surffish; hunting deer, elk, and sea lion; and collecting acorns (Pilling 1978). The present economy is based on small commercial development (Tiller 2005g).

The Smith River Rancheria reside in northern California near the Oregon border, and the population are members from the Tolowa Tribe. Traditional Tolowa subsistence was seasonally based and focused on fishing for salmon and smelt, hunting, acorn collecting, and plant gathering (Gould 1978); the current economy is based on tourism and gaming (Tiller 2005h).

The Cher-Ae Heights Indian Community of the Trinidad Rancheria live in northern California, and the population are members of the Wiyot, Yurok, and Tolowa Tribes. Traditional Wiyot subsistence included

harvesting shellfish, using sea mammals such as sea lions and stranded whales, hunting deer and elk, surf and saltwater fishing along the coast, and salmon fishing (Elsasser 1978). Yurok subsistence included harvesting shellfish; fishing for salmon, sturgeon, eel, candlefish, and surffish; hunting deer, elk, and sea lion; and collecting acorns (Pilling 1978). Traditional Tolowa subsistence was seasonally based and focused on fishing for salmon and smelt, hunting, acorn collecting, and plant gathering (Gould 1978). The present economy is based on tourism and gaming (Tiller 2005j).

The Wiyot Tribe (formerly the Table Bluff Rancheria) resides near Eureka in northern California and are members of the Wiyot Tribe (Tiller 2005i). Traditional Wiyot subsistence included harvesting shellfish, using sea mammals such as sea lions and stranded whales, hunting deer and elk, surf and saltwater fishing along the coast, and salmon fishing (Elsasser 1978).

The Yurok Indian Reservation is along the Klamath River in northern California, and the population are members of the Yurok Tribe. Yurok subsistence included harvesting shellfish; fishing for salmon, sturgeon, eel, candlefish, and surffish; hunting deer, elk, and sea lion; and collecting acorns (Pilling 1978). The current economy is based on small commercial development (Tiller 2005k).

In addition, fifteen other federally recognized tribes in Oregon and California may have concerns regarding traditional resources in Offshore Areas. These tribes include the Confederated Tribes of the Warm Springs Reservation, Cow Creek Band of Umpqua Indians, Klamath Tribes, Cahto Indian Tribe of the Laytonville Rancheria, Coyote Valley Band of Pomo Indians, Hoopa Valley Tribe, Hopland Band of Pomo Indians of the Hopland Rancheria, Karuk Tribe, Pinoleville Pomo Nation, Potter Valley Tribe, Redwood Rancheria of Pomo Indians, Robinson Rancheria of Pomo Indians, Round Valley Indian Tribes, Scotts Valley Band of Pomo Indians, and Sherwood Valley Rancheria of Pomo Indians.

3.11.1.4.3.2 Inland Waters

Nineteen federally recognized Native American tribes are currently or historically associated with the Inland Waters. The following Washington tribes may have usual and accustomed fishing rights in areas where the Navy conducts training and testing in the Inland Waters:

- Confederated Tribes and Bands of the Yakama Nation
- Jamestown S'Klallam Tribe
- Lower Elwha Klallam Tribe
- Lummi Tribe
- Makah Indian Tribe
- Muckleshoot Indian Tribe
- Nisqually Indian Tribe
- Nooksack Indian Tribe
- Port Gamble S'Klallam Tribe
- Puyallup Tribe
- Samish Indian Tribe
- Sauk-Suiattle Indian Tribe
- Skokomish Tribal Nation
- Squaxin Island Tribe
- Stillaguamish Tribe of Indians of Washington
- Suquamish Tribe
- Swinomish Indians of the Swinomish Reservation

- Tulalip Tribes of Washington
- Upper Skagit Indian Tribe

The Confederated Tribes and Bands of the Yakama Nation reside on the eastern slopes of the Cascade Mountains in south central Washington (Tiller 2005ao). The Yakama subsistence pattern was seasonally based and consisted of salmon fishing along the Columbia and Yakima rivers and their tributaries in the spring and early summer and hunting and plant gathering in the upper elevations during the summer and fall (Schuster 1998). The current tribal economy is diverse and includes agriculture, forestry, fisheries, tourism and recreation, gaming, and commercial enterprises (Tiller 2005an).

Klallam tribal groups include the Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Port Gamble S'Klallam Tribe. Tribal reservations are on the northern Olympic Peninsula and Kitsap Peninsula. Historically, Klallam peoples used the Hood Canal for summer fishing and gathering, especially for shellfish, herring, and salmon (Tiller 2005q; Point No Point Treaty Council 2011). The current economy of the Jamestown S'Klallam Tribe is based on art, seafood industries, commercial development, construction, information technology and communications, and gaming (Tiller 2005q). The present economy for the Lower Elwha Klallam Tribe includes salmon hatcheries, retail industries, and gaming (Tiller 2005r). The current economy of the Port Gamble S'Klallam Tribe includes aquaculture (salmon hatchery, geoduck fishery, fish and oyster growing), commercial enterprises, and gaming (Tiller 2005x).

The Lummi Tribe resides in northwest Washington. Before the Treaty of Point Elliot and reservation establishment, the Lummis occupied the northern San Juan Islands and the adjacent mainland, where they traveled to traditional reef-net locations. Salmon was their primary food source, and many ceremonies, beliefs, and community activities centered on salmon (Tiller 2005s). Presently, the economy is based primarily on salmon and shellfish hatcheries, small commercial developments, and gaming (Tiller 2005s).

The Makah Indian Tribe was described previously.

The Muckleshoot Indian Tribe lives east of the Seattle-Tacoma metropolitan area, but tribal ancestral homelands include areas along the eastern and southern reaches of Puget Sound. Historically, it depended on the abundance of natural resources, especially salmon and red cedar (Tiller 2005u). The foundation of today's tribal economy is based on gaming, fishing, and retail industries.

The Nisqually Indian Tribe resided in the woodlands and prairies of the Nisqually River basin. Today, its reservation is in western Washington, east of Olympia. It operates two major fish hatcheries on the Nisqually River and derive other income from gaming enterprises (Tiller 2005v).

The Nooksack Indian Tribe lives in the upper Nooksack River valley, in northeastern Washington. It is a Coast Salish nation whose traditional means of subsistence included fishing, hunting, clam digging, root gathering, and trading (Tiller 2005w). The present-day tribal economy is supported by enterprises such as service, retail, gaming, and fisheries, including operation of a fisheries laboratory and salmon-rearing pond.

The Puyallup Tribe resides on the Puyallup Reservation, south of Seattle, at the southern end of Puget Sound. Like many other Puget Sound groups, the Puyallup gathered salmon, shellfish, wild game, roots, and berries (Tiller 2005z). It is a major employer in King County, with a wide variety of enterprises such as gaming, a marina, media and communications, international shipping, and seafood ventures.

The Samish Indian Nation is currently landless with the tribal headquarters established on Fidalgo Island on the east side of Puget Sound near Anacortes. Traditional subsistence activities included hunting of deer, elk, seal, waterfowl and shore birds, gathering fruits and other plant foods, harvesting shellfish, and fishing. The current tribal economy is based on tourism and recreation, and retail enterprises (Tiller 2005an).

The Sauk-Suiattle Indian Tribe lives in the Sauk Prairie area east of Puget Sound. Historically, its members fished area rivers for salmon, often traveling down to Puget Sound to harvest fish and shellfish (Tiller 2005ac). Fishing continues to be a vital occupation for the tribe, and as part of the Skagit System Cooperative, the tribe helps to manage the state's salmon and steelhead resources.

The Skokomish Indian Tribe occupies the delta of the Skokomish River where it empties into the Hood Canal; the reservation was created by the Point No Point Treaty (Tiller 2005ae). The territory of the Twana or Skokomish people (whose descendents are now the Skokomish Tribal Nation) runs along both sides of the Hood Canal, where these people had winter villages, including the Quilcene and Dabob grounds near the Dabob Bay. They frequented Dabob Bay and surrounding beaches for seasonal salmon fishing and clam digging. The Twana assigned place names to four shoreline areas in the Dabob Bay area: Whitney Point was a summer campsite; "Pulali," as in Pulali Point, was probably derived from the native name of a wild cherry, *Pulela*; Zelatched Point was a summer campsite; and Sylopash Point was likely named for a probable mythological site. The tribe operates several businesses, including a fish hatchery, a fish processing plant, gas station, convenience store, and casino.

Squaxin Island Tribe (people of the water) includes descendents of the original maritime inhabitants of the seven inlets of south Puget Sound; the Squaxin Island Reservation is in Puget Sound. They are closely related to the Nisqually Tribe. They gathered oysters, clams, smelt, and herring for smoking and year-round consumption (Tiller 2005af). The tribal economy is based on fisheries, tourism, gaming, and small commercial development (Tiller 2005af).

The members of the Stillaguamish Tribe of Indians of Washington are descendants of the Stoluckwamish River Tribe but are referred to as Stillaguamish because of their traditional location along the Stillaguamish River. Their reservation is between the Cascade Mountains and Puget Sound. Historically, harvesting salmon, hunting goats, and gathering vegetative foods provided their subsistence base (Tiller 2005ag). Besides service and retail outlets, the Stillaguamish economy is now based on gaming and fisheries, including a fish hatchery.

The Suquamish Tribe occupies the Port Madison Reservation, which is on the Kitsap Peninsula and was set aside as part of the Point Elliot Treaty of 1855. Commercial fishing and shellfish harvest reflect the tribe's main source of income; other economy ventures include small commercial development, media and communications, tourism, and gaming (Tiller 2005y).

The Swinomish Indians of the Swinomish Reservation live on Fidalgo Island in Washington; the population consists of Swinomish, Kikiallus, Lower Skagit, and Samish tribal members (Tiller 2005ah). Historically, their subsistence lifestyle was based on salmon and other fish, supplemented with game, berries, nuts, and roots. Current income sources include businesses, government, agriculture, forestry, gaming, manufacturing, services, tourism, and fisheries.

Tulalip Tribes of Washington occupy their reservation west of the city of Marysville, on the Puget Sound. The term "Tulalip Tribes" refers to several allied tribes who traditionally made the area their homeland. Salmon harvest is an important part of the historic and contemporary economy (Tiller 2005ai). The

Tulalip Reservation economy is based on gaming, retail outlets, a marina, small commercial development, construction, mining, and a fish hatchery that "produces more than nine million salmon fingerlings annually" (Tiller 2005ai).

The Upper Skagit Indian Tribe resides just northeast of the Puget Sound, in the Cascades foothills. The Upper Skagit are descendants of 11 tribal bands and groups that occupied the Samish Bay and other river drainages in Washington. The tribe owns a fish hatchery at Helmick, and their major sources of tribal revenues are tourism, gaming, federal grants, and retail businesses (Tiller 2005aj).

3.11.1.4.3.3 Western Behm Canal, Alaska

Four federally recognized Alaska Native tribes are currently or historically associated with the Western Behm Canal:

- Central Council of the Tlingit and Haida Indian Tribes
- Ketchikan Indian Community
- Metlakatla Indian Community
- Organized Village of Saxman

The Central Council of the Tlingit and Haida Indian Tribes represent all Tlingit and Haida peoples; the Haida village of Hydaburg is located on the southwest coast of Prince of Wales island, northwest of Ketchikan (Tiller 2005 am). Traditional subsistence practices consist of fishing for salmon, halibut, crab and shrimp; hunting seals, porpoises, sea lions, fur seals, and sea otters; utilizing stranded whales; hunting deer, bear, and beaver; digging clams; and gathering berries and other plant resources (Blackman 1990, Stearns 1990). The current economy in Hydaburg includes fishing and forestry; traditional subsistence practices remain a focus of the Haida culture (Tiller 2005 am). Under the Alaska Native Claims Settlement Act, the Haida Corporation is the village corporation for Hydaburg (Stearns 1990). The village also is a shareholder with Sealaska Corporation, the regional Native corporation.

The Ketchikan Indian Community occupies the southwestern coast of Revillagigedo Island. Ketchikan Creek was originally used as a fishing camp by the Tongass and Cape Fox Tlingits. The Ketchikan Indian Community manages and operates the Deer Mountain tribal hatchery (Tiller 2005b). The hatchery produces more than 450,000 king, coho, steelhead, and rainbow trout annually (Tiller 2005b). The Ketchikan Indian Community was not included in the Alaska Native Claims Settlement Act but is recognized as an "Alaska Native Village" entity by the Bureau of Indian Affairs (Tiller 2005b).

The Metlakatla Indian Community lives within and controls the Annette Islands Reserve—the only native reserve in Alaska—on the Clarence Strait opposite Ketchikan. This community was established by Canadian Tsimshians who migrated in 1887 (Tiller 2005c). In 1891, Congress designated all waters within 3,000 nautical feet of the island as Reserve Waters, to be used exclusively by the members of the Metlakatla Indian Community. Therefore, all management of fisheries within this 3,000 nautical feet, as well as management of all wildlife species within the reserve, is the responsibility of the Metlakatla Indian Community and the Metlakatla Department of Fish and Wildlife. The tribal economy is based on fishing, fish processing, wood products industries, and services (Tiller 2005c). The Metlakatla Indian Community did not participate in the Alaska Native Claims Settlement Act.

The Organized Village of Saxman is south of Ketchikan on the west side of Revillagigedo Island. This Tlingit community was established in 1894 (Tiller 2005d). Under the Alaska Native Claims Settlement

Act, the Cape Fox Corporation is the village corporation for the Organized Village of Saxman. The village also is a shareholder with Sealaska Corporation, the regional Native corporation (Tiller 2005d).

3.11.2 AFFECTED ENVIRONMENT

The Study Area is divided into three distinct regions for Native American and Alaska Native resources evaluation: the Offshore Area, the Inland Waters, and the Western Behm Canal, Alaska. Native American and Alaska Native traditional resources presented in this section include traditional resources within 12 nm and protected tribal resources, such as usual and accustomed fishing areas, which extend beyond 12 nm.

3.11.2.1 Native American Resources Eligible for or Listed on the National Register of Historic Places

3.11.2.1.1 Offshore Area

No Native American traditional resources have been identified in the Offshore Area, including the 1-mile surf zone at Pacific Beach.

3.11.2.1.2 Inland Waters

No Native American traditional resources have been identified within the Inland Waters.

3.11.2.1.3 Western Behm Canal, Alaska

No Alaska Native traditional resources have been identified within the Study Area.

3.11.2.2 Native American Resources Eligible for or Listed on State Registers

3.11.2.2.1 Offshore Area

No Native American traditional resources have been identified in the Offshore Area, including the 1-mile surf zone at Pacific Beach.

3.11.2.2.2 Inland Waters

No Native American traditional resources have been identified within the Inland Waters.

3.11.2.2.3 Western Behm Canal, Alaska

No Alaska Native traditional resources have been identified within the Study Area.

3.11.2.3 Treaty Fishing Areas and Subsistence Use

3.11.2.3.1 Offshore Area

The Pacific Coast Treaty Indian Rights (50 C.F.R. 660.706) provides treaty rights to the Makah, Quileute, and Hoh Tribes and to the Quinault Indian Nation to harvest migratory species in their usual and accustomed fishing areas in U.S. waters. The Oregon and California tribes practice limited commercial and ceremonial and subsistence fisheries only in freshwater; they do not have any traditional resource collection areas within U.S. waters (within 12 nm). Specific Native Americans use of usual and accustomed tribal fishing grounds in the Offshore Area, including the Olympic Coast National Marine Sanctuary area, are as follows:

- Tribal landings of fish from the Offshore Area are centered on Grays Harbor, Quillayute, and Cape Flattery, where the Makah Tribe conducts a marine gillnet fishery.

- Willapa Bay is a usual and accustomed fishing area for the treaty tribes (Hoh, Makah, Quileute, and Quinault) (National Oceanic and Atmospheric Administration 1993). Chinook, coho, and pink salmon are the primary species taken and, along with steelhead trout, are harvested either by gillnets or troll gear. Coastal tribes (Hoh, Makah, Quileute, and Quinault) participate in a variety of commercial, ceremonial, and subsistence fisheries for groundfish and Pacific halibut, which are taken with a variety of fishing gears in the tribes' offshore usual and accustomed fishing areas off the northern coast of the Olympic Peninsula and the central coast of Washington. Tribes reserve the right to fish for groundfish with any type of fishing gear, including traps and trawl gear.
- The Quinault fishing fleet is based in Westport, Washington, and fishes the open ocean area from there north to Destruction Island. This fleet and a smaller river fleet also fish commercially within Grays Harbor.

The *Marine Resources Assessment for the Pacific Northwest Operating Area* (U.S. Department of the Navy 2006) contains a detailed written description of the usual and accustomed fishing grounds for the treaty tribes. This information is incorporated here by reference. There is overlap between tribal usual and accustomed areas and the locations of Navy training and testing.

3.11.2.3.2 Inland Waters

Specific Native American use of the usual and accustomed tribal fishing grounds in the Inland Waters, for both subsistence and commercial fishing is as follows:

- Tribes fish in the Strait of Juan de Fuca for Chinook and sockeye salmon. The Suquamish Tribe exercise usual and accustomed fishing rights within the Keyport Range Site portion of the Inland Waters.
- The Tulalip Tribe of Washington has usual and accustomed fishing rights from the Canadian border to Vashon Island, with the exception of 45 acres adjacent to Naval Station Everett.
- The Skokomish Indian Tribe has primary usual and accustomed fishing rights in the Hood Canal. As provided in the Hood Canal Agreement, the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam tribes also have fishing rights in the Hood Canal. The Suquamish Tribe has secondary rights in Hood Canal south of the Hood Canal Bridge, which means they are allowed to fish only with the express permission of the Skokomish Indian Tribe, and such permission has not been granted.
- The Skokomish Indian Tribe and the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam tribes fish regularly for salmon, geoduck, crab, shrimp, and other shellfish. In particular, beds of shellfish along the shores of Dabob Bay and Hood Canal near NAVBASE Kitsap Bangor are regularly harvested by the tribes.
- The Swinomish Indians of the Swinomish Reservation, Suquamish Tribe, and Upper Skagit Indian Tribe have access to installation beach areas at Crescent Harbor for shellfish harvesting.
- The Jamestown S'Klallam Tribe of Washington, Lower Elwha Klallam Tribe, Lummi Tribe, Makah Indian Tribe, Muckleshoot Indian Tribe, Nisqually Indian Tribe, Nooksack Indian Tribe, Port Gamble S'Klallam Tribe, Puyallup Tribe, Sauk-Suiattle Indian Tribe, Skokomish Tribal Nation, Squaxin Island Tribe, Suquamish Tribe, Stillaguamish Tribe of Indians of Washington, Swinomish Indians of the Swinomish Reservation, Tulalip Tribe of Washington, and Upper Skagit Indian Tribe have access to tidelands around Puget Sound, including Carr Inlet and areas near NAVBASE Kitsap Bremerton for finfish and shellfish harvesting.

The *Marine Resources Assessment for the Pacific Northwest Operating Area* (U.S. Department of the Navy 2006) contains a detailed written description of the usual and accustomed fishing grounds for the treaty tribes. This information is incorporated here by reference. There is overlap between tribal usual and accustomed areas and the locations of Navy training and testing.

3.11.2.3.3 Western Behm Canal, Alaska

Although subsistence hunting and fishing are economically and culturally important for many Alaska Native Tribes, the Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in Western Behm Canal.

3.11.2.4 Current Practices

The Navy has established protective measures to reduce potential effects on cultural and natural resources from training and testing exercises. Some are generally applicable, while others apply to particular geographic areas during specific times of year for certain types of Navy training activities. These measures are based on environmental analyses conducted by the Navy for coastal waters. While most of these protective measures focus on protection of the natural environment, they also benefit culturally valued natural resources, such as salmon and shellfish. Some of the protective measures include avoidance of known submerged obstructions, use of inert ordnance and passive tracking and acoustical tools, and avoidance of sensitive habitats to ensure that significant concentrations of sea life are not present.

3.11.2.4.1 Reduction of Vessel Traffic in Offshore Tribal Treaty Fishing Grounds

In 2002, areas along the northwest Washington coastline were designated for avoidance by ships and barges carrying oil or hazardous materials and by all ships of 1,600 gross tons and above that are solely in transit (Puget Sound Harbor Safety Committee 2008). This area to be avoided has helped reduce nearshore vessel traffic and traffic within the tribal treaty fishing grounds and is helping to protect the Olympic Coast National Marine Sanctuary and its resources valued by tribes. This voluntary measure places no new requirements on Navy ships. In the open ocean, most of the Pacific Coast Treaty Tribal Fishing Grounds are within the Olympic Coast National Marine Sanctuary, which is within Warning Areas 237A and 237B (W-237A and W-237B). Navy activities within the Olympic Coast National Marine Sanctuary and military activity exemptions for current activities are established in 15 C.F.R. 922.152, Chapter IX, Subpart O, Olympic Coast National Marine Sanctuary.

3.11.2.4.2 Tribal Coordination for Naval Undersea Warfare Center Division, Keyport Range Site Activities

At NUWC Division, Keyport, the Navy exchanges information with the Suquamish Tribe to avoid disruption of tribal usual and accustomed fishing patterns. The Navy notifies affected tribes and nations when NUWC Division, Keyport activities are scheduled on the range site.

3.11.2.4.3 Tribal Coordination for the Dabob Bay Range Complex Site Activities

At the Dabob Bay Range Complex (DBRC) Site, the Navy exchanges information with the Jamestown S'Klallam Tribe, the Lower Elwha Klallam Tribe, the Port Gamble S'Klallam Tribe, and the Skokomish Tribal Nation. The Point No Point Treaty Council was also included in discussions. After some initial information exchange, a draft communication protocol was provided to the tribes and comments were incorporated. NUWC Division Keyport provides a weekly schedule of range activity for the DBRC. As part of this activity report there is an estimated range usage time. This schedule is sent to the points of

contact established by e-mail during consultation. Any significant emergent changes/updates to this schedule are sent to the points of contact via e-mail as they may occur. The affected Tribes provide a copy of the Annual Regulations for the various Tribal fisheries through the Point No Point Treaty Council to the NUWC Division Keyport. The Point No Point Treaty Council also notifies the NUWC Division Keyport of any emergency regulations that are made during the year. Finalization of the DBRC Site environmental assessment and finding of no significant impact established an information exchange between the tribes and the Navy as a mitigation measure; and NUWC Division, Keyport continues to maintain communications about upcoming testing activities to the Tribes.

3.11.2.4.4 Tribal Coordination for Quinault Range Site Activities

Communications were initiated between Navy representatives from NUWC Division, Keyport and representatives of the affected tribes for the Quinault Range Site. Navy representatives met with the Hoh Tribe on 6 November 2003, the Quileute Tribe on 12 November 2003, and the Quinault Nation on 8 November 2003 to initiate government-to-government consultation. NUWC Division, Keyport would establish a communication process with the Hoh Tribe, Makah Tribe, Quileute Tribe, and Quinault Nation similar to the process established with affected tribes for the DBRC Site. This would establish points of contact to exchange information on NUWC Division, Keyport testing activity and tribal fishing regulations in order to avoid disruption of tribal usual and accustomed fishing patterns.

3.11.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 could impact Native American and Alaska Native traditional resources of the Study Area. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including numbers of events and ordnance expended). Section 3.0 and Appendix A describe the warfare areas and associated stressors that were considered for analysis of Native American and Alaska Native traditional resources. The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to Native American and Alaska Native traditional resources include:

- Accessibility
- Airborne Acoustics
- Physical Disturbance and Strike Stressors (activities using seafloor devices and deposition of military expended materials)
- Secondary Impacts (from changes to the availability of marine resources)

Tribes have expressed concerns that training activities adversely affect fish and other maritime resources. For example, fish could be affected by vessel movement, aircraft overflights, underwater explosions, weapons firing, and large objects hitting the water. Fish habitat could be modified or damaged. Tribes have also suggested there could be direct effects on fish populations and other marine resources from Navy training activities using sonar. However, analysis suggests that Navy training and testing activities would not result in significant impacts on resources valued by tribes. For an evaluation of the effects of Navy training and testing activities, see Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles), 3.6 (Birds), and 3.9 (Fish).

Tribes also have expressed concerns that fish, shellfish, and other marine species could be affected by contaminants from expended materials. Expended materials can build up in sediments, but these generally are transported by tidal and wave action. Eventually, potentially hazardous constituents are dispersed and diluted to a level that would be below a level of water quality that would affect living organisms (see Section 3.1, Sediments and Water Quality).

Some protective measures already put in place by the Navy for endangered and threatened species would help protect species valued by tribes; see Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles), 3.6 (Birds), and 3.9 (Fish). Per 33 C.F.R. 72.01-1–01.35, U.S. Notices to Mariners (NTMs) are prepared with inputs from the National Geospatial-Intelligence Agency, National Oceanic and Atmospheric Administration's (NOAA's) National Ocean Service, the U.S. Coast Guard, and other sources such as the Navy, and provide timely marine safety information for paper and electronic navigation charts and publications. The Navy provides the U.S. Coast Guard with information on the locations of potentially hazardous training or testing activities at sea so the Coast Guard can issue NTMs. In some instances, the Navy has directly notified affected Native American tribes to ensure that their activities in usual and accustomed fishing areas can avoid any potentially hazardous training or testing locations at sea.

Some ethnographic concerns center on limits on access for fishing, including restricted access to tribal usual and accustomed fishing grounds or shellfish procurement areas. Because the Study Area overlaps the tribal usual and accustomed use areas, Navy training and testing activities may be underway at a time when tribes would like to access a particular use area. Some traditionally used areas may be inaccessible because of safety concerns relating to, for example, ordnance storage or testing. Thus, there is potential for conflict in timing and access between Navy training activities and desired traditional uses. The Navy would strive to maintain safety and accommodate, to the extent possible, access to tribes' usual and accustomed areas.

Table 3.11-1 presents quantitative data (number of components or activities) for the analysis of each stressor applicable to Native American and Alaska Native traditional resources. When data is not applicable or available, a qualitative analysis is presented and noted accordingly in the table. The specific analysis of the training and testing activities presented in this section considers relevant components and associated data with the geographic location of the activity and the resource. Training activities are not proposed in the Western Behm Canal; therefore, only the Offshore Area and the Inland Waters will be analyzed under Training Activities.

Table 3.11-1: Stressors Applicable to Native American and Alaska Native Traditional Resources for Training and Testing Activities

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Accessibility							
Activities including vessels	Offshore Area	996	37	1096	138	1096	162
	Inland Waters	4	337	28	582	28	640
	W. Behm Canal	0	28	0	60	0	83
Airborne Acoustics							
Activities including aircraft	Offshore Area	3,826	2	6,471	74	6,471	84
	Inland Waters	124	2	127	20	127	25
	W. Behm Canal	0	0	0	0	0	0
Physical Disturbance and Interactions							
Activities using seafloor devices	Offshore Area	0	5	0	6	0	7
	Inland Waters	2	210	16	225	16	239
	W. Behm Canal	0	0	0	5	0	15
Military expended materials	Offshore Area	189,668	621	196,888	2,511	196,888	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Secondary Impacts							
Availability of resources	Offshore Area	QUALITATIVE					
	Inland Waters						
	W. Behm Canal						

3.11.3.1 Accessibility

Navy training and testing activities have the potential to temporarily limit access to areas of the ocean for a variety of human activities associated with protected tribal resources and other traditional resources of Native American and Alaska Native Tribes in the Study Area. No traditional resources have been identified in the Study Area, and accessibility to such resources would not be affected.

In some instances, marine traffic is halted to eliminate acoustic interference during noise-sensitive testing. Typically, marine traffic is allowed to pass during the interval between test activities. When training or testing activities are scheduled that require specific areas to be free of nonparticipating vessels because of possible hazards to navigation, the Navy may request that the U.S. Coast Guard issue NTMs to warn the public of upcoming Navy activities. Training and testing activities occur in established restricted or danger areas, as published on navigation charts. For most testing activities, halting marine traffic is typically not required because activities run at sufficient depth and have no live warheads that would present a risk to surface vessels. The DBRC Site has unique fixed warning lights that warn nonmilitary craft of the status of Navy activities. The descriptions of the lights are posted at local boat ramps and marinas and are clearly indicated on standard NOAA charts (e.g., NOAA Nautical Chart No. 18458). In accordance with 32 C.F.R. Part 761, a 500-yard (yd.) (457-meter [m]) protection zone is established around all U.S. Navy vessels in navigable waters of the United States and within the boundaries of the U.S. Coast Guard Pacific Area. All vessels must proceed at a no-wake speed within a

protection zone. Nonmilitary vessels are not permitted to enter within 100 yd. (91.4 m) of a U.S. naval vessel, whether underway or moored, unless authorized by an official patrol.

The changes in accessibility to human activities in the ocean or inland waterways would be an impact if they directly contributed to loss of income, revenue, or employment. Disturbance to human activities that result in impacts is quantified by the amount of time the activity may be halted or rerouted or by the ability to move to another location.

3.11.3.1.1 No Action Alternative

3.11.3.1.1.1 Training

Offshore Area

The Offshore Area of the Study Area includes established Navy OPAREAs used for military training activities. Native American vessels entering OPAREAs within the Study Area, including established restricted areas, operate under maritime regulations and are not limited by Navy activities. NTMs advise Native American fishermen, among others, that the military will be performing hazardous activities in a specific area, allowing them to plan their activities accordingly. These temporary clearance procedures are established and implemented for the safety of the public and have been employed regularly over time without significant accessibility issues.

Upon completion of training, the range would be reopened and fishermen could return to fish in the previously closed area. To help manage competing demands and maintain public access in the Study Area, the Navy conducts its offshore operations in a manner that minimizes restrictions to Native American fisherman. Navy ships, fishermen, and other users strive to operate within the area together and keep a safe distance between each other, and Navy exercise participants relocate as necessary to avoid conflicts with nonparticipants.

Accessibility, or restrictions to the availability of ocean space, would be a temporary condition. While mariners have a responsibility to be aware of conditions on the ocean, it is not expected that direct conflicts in accessibility would occur because the Navy follows standard operating procedures to visually scan an area to ensure that nonparticipants are not present before initiating any training activity. If nonparticipants are present, the Navy delays, moves, or cancels its activity. Tribal accessibility is no longer restricted once the activity concludes.

Under the No Action Alternative, potential accessibility impacts would be associated primarily with anti-air warfare, anti-surface warfare, anti-submarine warfare, mine warfare, and naval special warfare. Training activities would continue at current levels and within established ranges and training locations (see Table 3.11-1). There would be no anticipated impacts on Native American traditional resources because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration (hours).

Inland Waters

Subsistence and commercial fishing activities make an appreciable contribution to the overall Native American economy within the Study Area. Since the early 1900s, the Navy has conducted training exercises within the Inland Waters and provided NTMs about the Navy's activities. This helps to circumvent fishing regulations that change almost on an annual basis. The Navy has performed military activities within this region in the past and has not barred fishing uses. The temporary closure of areas within the Study Area due to security, safety, and test requirements to maintain all quiet around the test

vessel or test systems does not limit Native American access to surrounding areas. Areas are temporarily closed only for the duration of the activity and are reopened at the completion of the activity.

The temporary range clearance procedures for safety do not adversely affect subsistence and commercial fishing activities because displacement is of short duration (less than 24 hours). When range clearance is required because of potential navigational hazards, the public may be notified through NTMs. Temporary range clearance is required for training activities that require all-quiet conditions around the test vessel or test systems; fixed warning lights at Dabob Bay are used to warn nonmilitary craft of the status of activities. These measures provide mariners with advance notice of areas being used by the Navy for training activities. This allows the Native American fisherman to select an alternate destination without appreciable effect on their activities.

The Navy does not exclude fishing activities from areas of the Study Area that it is not using. The Navy has been conducting training activities within the Study Area for decades, and it has taken, and will continue to take, measures to prevent interruption of Native American subsistence and commercial fishing activities. To minimize potential military/Native American interactions, the Navy will continue to publish scheduled operation times and locations through U.S. Coast Guard-issued NTMs. Other ways in which fishermen can determine access status is to contact range control and monitor very high frequency channel 16 (VHF-16). These efforts are intended to ensure that subsistence and commercial users are aware of the Navy's plans and allow users to plan their activities to avoid scheduled Navy activities. Therefore, decreases in the frequency of fishing trips or in the availability of desirable fishing locations because of Navy activities are not expected.

For safety reasons, the Navy may restrict access to a specific surface water area through the establishment of an exclusion zone, which would temporarily limit Native American subsistence and commercial fishing in that specific area; however, other areas in the Study Area would remain open to subsistence and commercial fishing. A Navy activity involving the use of explosive ordnance is one example of an activity that could require establishment of a temporary exclusion zone. Typically, an exclusion zone is established only for a few hours and extends over a circular area with a radius of about 2 miles (depending on the activity). Native American subsistence and commercial fishing activities could occur in the area before and after the temporary restriction. Should the Navy find nonparticipants present in an exclusion zone, the Navy would halt or delay (and reschedule, if necessary) all potentially hazardous activity until the nonparticipants have exited the exclusion zone.

Under the No Action Alternative, potential accessibility impacts would be associated primarily with naval special warfare and mine warfare. Training activities would continue at current levels and within established ranges and training locations (see Table 3.11-1). There would be no anticipated impacts on Native American protected tribal resources or other traditional resources because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration (hours).

No impacts on Native American protected tribal resources or other traditional resources would occur under the No Action Alternative because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration during training activities.

3.11.3.1.1.2 Testing

Offshore Area

The Offshore Area of the Study Area includes established Navy OPAREAs used for military testing activities. Native American vessels entering OPAREAs within the Study Area, including established

restricted areas, operate under maritime regulations and are not limited by Navy activities. NTMs advise Native American fishermen, among others, that the military will be performing hazardous activities in a specific area, allowing them to plan their activities accordingly. These temporary clearance procedures are established and implemented for the safety of the public and have been employed regularly over time without significant accessibility issues.

Upon completion of testing, the range would be reopened and fishermen could return to fish in the previously closed area. To help manage competing demands and maintain public access in the Study Area, the Navy conducts its offshore operations in a manner that minimizes restrictions to Native American fisherman. Navy ships, fishermen, and other users strive to operate within the area together and keep a safe distance between each other, and Navy exercise participants relocate as necessary to avoid conflicts with nonparticipants.

Accessibility, or restrictions to the availability of ocean space, would be a temporary condition. While mariners have a responsibility to be aware of conditions on the ocean, it is not expected that direct conflicts in accessibility would occur because the Navy follows standard operating procedures to visually scan an area to ensure that nonparticipants are not present before initiating any testing activity. If nonparticipants are present, the Navy delays, moves, or cancels its activity. Tribal accessibility is no longer restricted once the activity concludes.

Under the No Action Alternative, potential accessibility impacts would be associated primarily with testing, evaluation, and maintenance of systems and platforms. Testing activities would continue at current levels and within established ranges and testing locations (see Table 3.11-1). There would be no anticipated impacts on Native American protected tribal resources and other traditional resources because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be infrequent and of short duration (hours).

Inland Waters

Subsistence and commercial fishing activities make an appreciable contribution to the overall Native American economy within the Study Area. Since the early 1900s, the Navy has conducted training exercises within the Inland Waters and provided NTMs about the Navy's activities. This helps circumvent fishing regulations that change almost on an annual basis. The Navy has performed military activities within this region in the past and has not barred fishing uses. The temporary closure of areas within the Study Area due to security, safety, and test requirements to maintain all quiet around the test vessel or test systems does not limit Native American access to surrounding areas. Areas are temporarily closed only for the duration of the activity and are reopened at the completion of the activity.

The temporary range clearance procedures for safety do not adversely affect subsistence and commercial fishing activities because displacement is of short duration (less than 24 hours). When range clearance is required because of potential navigational hazards, the public may be notified through NTMs. Temporary range clearance is required for testing activities that require all-quiet conditions around the test vessel or test systems; fixed warning lights at Dabob Bay are used to warn nonmilitary craft of the status of activities. These measures provide mariners with advance notice of areas being used by the Navy for testing activities. This allows the Native American fisherman to select an alternate destination without appreciable effect on their activities.

The Navy does not exclude fishing activities from areas of the Study Area that it is not using. The Navy has been conducting training and testing activities within the Study Area for decades, and it has taken,

and will continue to take, measures to prevent interruption of Native American subsistence and commercial fishing activities. To minimize potential military/Native American interactions, the Navy will continue to publish scheduled operation times and locations through U.S. Coast Guard-issued NTMs. Other ways in which fishermen can determine access status is to contact range control and monitor VHF-16. These efforts are intended to ensure that subsistence and commercial users are aware of the Navy's plans and allow users to plan their activities to avoid scheduled Navy testing activities. Therefore, decreases in the frequency of fishing trips or in the availability of desirable fishing locations because of Navy activities are not expected.

For safety reasons, the Navy may restrict access to a specific surface water area through established exclusion zones (indicated on nautical charts provided by NOAA and established in consultation with other agencies), which would temporarily limit Native American subsistence and commercial fishing in that specific area; however, other areas in the Study Area would remain open to subsistence and commercial fishing. A Navy activity involving the use of explosive ordnance is one example of an activity that could require establishment of a temporary exclusion zone. Typically, an exclusion zone is established only for a few hours and extends over a circular area with a radius of about 2 miles (depending on the activity). Native American subsistence and commercial fishing activities could occur in the area before and after the temporary restriction. Should the Navy find nonparticipants present in an exclusion zone, the Navy would halt or delay (and reschedule, if necessary) all potentially hazardous activity until the nonparticipants have exited the exclusion zone.

Under the No Action Alternative, potential accessibility impacts would be associated primarily with testing, evaluation, and maintenance of systems and platforms. Testing activities would continue at current levels and within established ranges and testing locations (see Table 3.11-1). There would be no anticipated impacts on Native American protected tribal resources and other traditional resources because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration (hours).

Western Behm Canal, Alaska

During operations, the Navy can close the restricted area to all vessel traffic, although normally such closures will not exceed 20 minutes. Small craft may operate within 500 yd. (457 m) of the shoreline at speeds no greater than 5 knots during closure periods. These closures minimize ambient underwater sound levels during testing to ensure integrity of the testing and to fully accomplish SEAFAC's mission. They also help protect public safety during testing events.

The Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in the Western Behm Canal. Because the Western Behm Canal does not contain any Alaska Native protected tribal resources or other traditional resources or fishing areas, no impact on Alaska Native protected tribal resources or other traditional resources would occur as a result of testing activities.

No impacts on Native American protected tribal resources or other traditional resources would occur under the No Action Alternative because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration during testing activities.

3.11.3.1.2 Alternative 1

3.11.3.1.2.1 Training

Offshore Area

Training activities as described under the No Action Alternative would continue, increasing in frequency for some activities within the Study Area as compared with the No Action Alternative (see Table 3.11-1). There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any training activity. Under Alternative 1, potential impacts affecting accessibility to areas of the Study Area would be the same as those associated with the No Action Alternative. Despite the increase in frequency of some training activities and the additional areas to be analyzed, no impacts from Alternative 1 activities on the accessibility to Native American protected tribal resources or other traditional resources would occur.

Inland Waters

Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities are all within Puget Sound and include NAVBASE Kitsap Bremerton in Sinclair Inlet, NAVBASE Kitsap Bangor Waterfront in Hood Canal, and Naval Station Everett. The nearshore and marine waters of Sinclair Inlet are within the "usual and accustomed" fishing and shellfishing areas of the Suquamish Tribe. The Skokomish Indian Tribe and the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes harvest shellfish south of Delta Pier at NAVBASE Kitsap Bangor Waterfront in Hood Canal. Nearshore and adjacent water areas associated with these pierside locations are restricted from tribal and general public use.

Training activities would continue, increasing in frequency for some activities and introducing new activities within the Study Area as compared with the No Action Alternative (see Table 3.11-1). Since the early 1900s, the Navy has conducted training exercises within the Inland Waters and provided NTMs about the Navy's activities. This helps circumvent fishing regulations that change almost on an annual basis. There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any training activity. Despite the increase in frequency of training activities and the introduction of additional activities, no impacts from Alternative 1 activities on the accessibility to Native American protected tribal resources or other traditional resources would occur.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 1 because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration during training activities.

3.11.3.1.2.2 Testing

Offshore Area

Testing activities as described under the No Action Alternative would continue, increasing in frequency for some activities within the Study Area as compared with the No Action Alternative (see Table 3.11-1). There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any testing activity. Under Alternative 1, potential impacts affecting accessibility to areas of the Study Area would be the same as those associated with the No Action Alternative. Despite the increase in frequency of some testing activities and the additional areas to be analyzed, no impacts from Alternative 1 activities on the accessibility to Native American protected tribal resources or other traditional resources would occur.

Inland Waters

Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities are all within Puget Sound and include NAVBASE Kitsap Bremerton in Sinclair Inlet, NAVBASE Kitsap Bangor Waterfront in Hood Canal, and Naval Station Everett. The nearshore and marine waters of Sinclair Inlet are within the "usual and accustomed" fishing and shellfishing areas of the Suquamish Tribe. The Skokomish Indian Tribe and the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes harvest shellfish south of Delta Pier at NAVBASE Kitsap Bangor Waterfront in Hood Canal. Nearshore and adjacent water areas associated with these pierside locations are restricted from tribal and general public use.

Testing activities would continue, increasing in frequency for some activities within the Study Area as compared with the No Action Alternative (see Table 3.11-1). Testing at Carr Inlet OPAREA would resume. Since the early 1900s, the Navy has conducted training exercises within the Inland Waters and provided NTMs about the Navy's activities. This helps circumvent fishing regulations that change almost on an annual basis. There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any testing activity. Despite the increase in frequency of testing activities and the additional areas to be analyzed, no impacts from Alternative 1 activities on the accessibility to Native American protected tribal resources or other traditional resources would occur.

Western Behm Canal, Alaska

The Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in the Western Behm Canal. Because the Western Behm Canal does not contain any Alaska Native protected tribal resources or other traditional resources or fishing areas, no impact on Alaska Native protected tribal resources or other traditional resources would occur as a result of testing activities.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 1 because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration during testing activities.

3.11.3.1.3 Alternative 2

3.11.3.1.3.1 Training

Offshore Area

Training activities as described under Alternative 2 would continue, increasing in frequency within the Study Area as compared with the No Action Alternative and matching the number of activities under Alternative 1 (see Table 3.11-1). There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any training activity. Despite the increase in frequency of training activities, no impacts from Alternative 2 activities on the accessibility to Native American protected tribal resources or other traditional resources are anticipated because training activities would place only short-duration (hours) restrictions on use of scheduled training areas.

Inland Waters

Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities are all within Puget Sound and include NAVBASE Kitsap Bremerton in Sinclair Inlet, NAVBASE Kitsap Bangor Waterfront in Hood Canal, and Naval Station Everett. The

nearshore and marine waters of Sinclair Inlet are within the "usual and accustomed" fishing and shellfishing areas of the Suquamish Tribe. The Skokomish Indian Tribe and the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes harvest shellfish south of Delta Pier at NAVBASE Kitsap Bangor Waterfront in Hood Canal. Nearshore and adjacent water areas associated with these pierside locations are restricted from tribal and general public use.

Training activities would continue, increasing in frequency for some activities and introducing new activities within the Study Area as compared with the No Action Alternative. (see Table 3.11-1). The proposed adjustments to Alternative 1 training activities include increasing the integrated maritime homeland defense/security mine countermeasures exercise frequency to an annual event. Since the early 1900s, the Navy has conducted training exercises within the Inland Waters and provided NTMs about the Navy's activities. This helps circumvent fishing regulations that change almost on an annual basis. There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any training activity. Despite the increase in frequency of training activities and the introduction of additional activities, no impacts from Alternative 2 activities on the accessibility to Native American protected tribal resources or other traditional resources would occur. No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 2 because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration during training activities.

3.11.3.1.3.2 Testing

Offshore Area

Testing activities as described under Alternative 2 would continue, increasing in frequency within the Study Area as compared with the No Action Alternative and Alternative 1 (see Table 3.11-1). There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any testing activity. Despite the increase in frequency of testing activities, no impacts from Alternative 2 activities on the accessibility to Native American protected tribal resources or other traditional resources are anticipated because testing activities would place only short-duration (hours) restrictions on use of scheduled testing areas.

Inland Waters

Navy pierside locations where sonar maintenance and testing occurs as part of overhaul, modernization, maintenance, and repair activities are all within Puget Sound and include NAVBASE Kitsap Bremerton in Sinclair Inlet, NAVBASE Kitsap Bangor Waterfront in Hood Canal, and Naval Station Everett. The nearshore and marine waters of Sinclair Inlet are within the "usual and accustomed" fishing and shellfishing areas of the Suquamish Tribe. The Skokomish Indian Tribe and the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes harvest shellfish south of Delta Pier at NAVBASE Kitsap Bangor Waterfront in Hood Canal. Nearshore and adjacent water areas associated with these pierside locations are restricted from tribal and general public use.

Testing activities would continue, increasing in frequency within the Study Area as compared with the No Action Alternative and Alternative 1 (see Table 3.11-1). Since the early 1900s, the Navy has conducted training exercises within the Inland Waters and provided NTMs about the Navy's activities. This helps circumvent fishing regulations that change almost on an annual basis. There would be no changes to the Navy's current protocol to visually scan an area in order to ensure that nonparticipants are not present before initiating any testing activity Despite the increase in frequency of testing

activities and the additional areas to be analyzed, no impacts from Alternative 2 activities on the accessibility to Native American protected tribal resources or other traditional resources would occur.

Western Behm Canal, Alaska

The Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in the Western Behm Canal. Because the Western Behm Canal does not contain any Alaska Native protected tribal resources or other traditional resources or fishing areas, no impact on Alaska Native protected tribal resources or other traditional resources would occur as a result testing activities.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 2 because inaccessibility to areas of co-use, such as usual and accustomed fishing areas, would be of short duration during testing activities.

3.11.3.2 Airborne Acoustics

Loud noises, sonic booms, and vibrations generated from Navy training and testing activities such as weapons firing, in-air explosions, and aircraft transiting have the potential to disrupt the use of Native American and Alaska Native traditional resources, such as locations of historic and contemporary events or ceremonies, sacred areas, and cultural landscapes in the Study Area. Noise interference would diminish the natural silence which is required by Native American and Alaska Native tribes honoring sacred locations or conducting ceremonies. These impacts would occur on a temporary basis and only when weapons firing, in-air explosions, and aircraft transiting occur.

No Native American traditional resources have been identified in the Offshore Area or in the Inland Waters, and no Alaska Native traditional resources have been identified in the Western Behm Canal. Airborne acoustics will not impact any Native American or Alaska Native traditional resources that would be considered sensitive to noise or vibration intrusions; therefore, no further analysis is needed.

Airborne acoustics would not disrupt protected tribal resources or other traditional resources such as usual and accustomed fishing or shellfish collecting areas; therefore, no further analysis is required.

3.11.3.3 Physical Disturbance and Strike Stressors

The evaluation of impacts on Native American and Alaska Native protected tribal resources and other traditional resources from physical disturbance and interaction stressors focuses on direct physical encounters or collisions with objects resting on the ocean floor (e.g., anchors, mines, targets) or dropped or fired into the water (e.g., non-explosive practice munitions, other military expended materials, and ocean bottom deployed devices), that may damage or encounter Native American or Alaska Native fishing equipment. No traditional resources have been identified in the Study Area, and physical disturbance and interactions to such resources would not occur.

Most Native American commercial fishing occurs beyond 3 nm in Navy training and testing areas and could be affected by proposed activities if those activities were to alter fish population levels in those areas to such an extent that commercial fishers could no longer find their target species. As described in Section 3.9.3 (Fish – Environmental Consequences), the behavioral responses that could occur from various types of physical stressors associated with training and testing activities would not compromise the general health or condition of fish and, therefore, Native American commercial or subsistence fishing resources would also not be compromised.

3.11.3.3.1 Impacts from Activities Using Seafloor Devices

Native American commercial fishing activities have the potential to interact with equipment placed in the ocean or on the ocean floor for use during proposed Navy training and testing activities. This equipment could include ship anchors, moored or bottom-mounted targets, mines and mine shapes, and tripods. Many different types of commercial fishing gear are used in the Study Area, including gillnets, longline gear, troll gear, trawls, seines, and traps or pots. Native American commercial bottom-fishing activities that use these types of gear have a greater potential to be affected by interaction with Navy training and testing equipment, resulting in the loss of or damage to both the Navy equipment and the commercial fishing gear.

Damage to fishing gear from Navy mine and submarine warfare activities in the Offshore Area is rare. When damage does occur to tribal and commercial fishing gear due to Navy actions (e.g., net entanglement, destructions of buoys), the fishermen (or the owner of the property damaged) can file a claim and request reimbursement. Forms for filing a claim can be obtained from http://www.jag.navy.mil/organization/code_15_packets_forms.htm. Reimbursement requests must be made within 2 years of incurring damage.

The Navy recovers many of the targets (e.g., mines and mine shapes) and target fragments used in training and testing activities, and it would continue to do so to minimize the potential for interaction with Native American fishing gear and fishing vessels. Unrecoverable items are typically small, constructed of soft materials (such as target cardboard boxes or tethered target balloons), or intentionally designed to sink to the bottom after serving their purpose, so they would not represent a collision risk to vessels, including commercial fishing vessels. Native American commercial fishing activities that drag gear along the bottom could snag unrecoverable items.

3.11.3.3.2 No Action Alternative

3.11.3.3.2.1 Training

Offshore Area

No training activities using seafloor devices in the Offshore Area are included in the No Action Alternative (see Table 3.11-1). Therefore, Native American protected tribal resources or other traditional resources would not be affected by training activities in the No Action Alternative.

Inland Waters

Under the No Action Alternative, training activities using seafloor devices would continue at current levels (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these training activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities using seafloor devices in the No Action Alternative would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement for the loss or damage of fishing gear may be possible in certain circumstances.

No impacts on Native American protected tribal resources or other traditional resources would occur under the No Action Alternative; however, loss or damage to Native American fishing equipment from the use of seafloor devices during training activities could occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

3.11.3.3.2.2 Testing

Offshore Area

Under the No Action Alternative, testing activities using seafloor devices would continue at current levels and within established ranges and testing locations (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities using seafloor devices in the No Action Alternative would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement for the loss or damage of fishing gear may be possible in certain circumstances.

Inland Waters

Testing activities using seafloor devices would continue at current levels and within established ranges and testing locations (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities using seafloor devices in the No Action Alternative would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement for the loss or damage of fishing gear may be possible in certain circumstances.

Western Behm Canal, Alaska

The Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in the Western Behm Canal. Because the Western Behm Canal does not contain any Alaska Native protected tribal resources or other traditional resources or fishing areas, no impact on Alaska Native protected tribal resources or other traditional resources would occur as a result of testing activities using seafloor devices.

No impacts on Native American protected tribal resources or other traditional resources would occur under the No Action Alternative; however, loss or damage to Native American fishing equipment from the use of seafloor devices during testing activities could occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

3.11.3.3.3 Alternative 1

3.11.3.3.3.1 Training

Offshore Area

Under Alternative 1, no new training activities using seafloor devices would occur (see Table 3.11-1). Therefore, Native American protected tribal resources or other traditional resources would not be affected by training activities in Alternative 1.

Inland Waters

Under Alternative 1, training activities using seafloor devices would increase in the Inland Waters as compared to the No Action Alternative (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these training activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities using seafloor devices in Alternative 1 would occur. A

system for filing damage claims against the Navy exists, and obtaining reimbursement for the loss or damage of fishing gear may be possible in certain circumstances.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 1; however, loss or damage to Native American fishing equipment from the use of seafloor devices during training activities could occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

3.11.3.3.3.2 Testing

Offshore Area

Testing activities using seafloor devices would increase within established ranges and testing locations as compared with the No Action Alternative (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities using seafloor devices in Alternative 1 would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

Inland Waters

Testing activities using seafloor devices would increase within established ranges and testing locations as compared with the No Action Alternative (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 1 testing activities using seafloor devices are anticipated. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

Western Behm Canal, Alaska

The Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in the Western Behm Canal. Because the Western Behm Canal does not contain any Alaska Native traditional resources or fishing areas, no impact on Alaska Native traditional resources would occur as a result of an increase of testing activities using seafloor devices.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 1; however, loss or damage to Native American fishing equipment from the use of seafloor devices during testing activities could occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

3.11.3.3.4 Alternative 2

3.11.3.3.4.1 Training

Offshore Area

Under Alternative 2, there are no new training activities that use seafloor devices (see Table 3.11-1). Therefore, Native American protected tribal resources or other traditional resources would not be affected by training activities in Alternative 2.

Inland Waters

Under Alternative 2, training activities using seafloor devices would increase in the Inland Waters as compared to the No Action Alternative and would be the same as Alternative 1 (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these training activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities using seafloor devices in Alternative 2 would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement for the loss or damage of fishing gear may be possible in certain circumstances.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 2; however, loss or damage to Native American fishing equipment from the use of seafloor devices during training activities could occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

3.11.3.3.4.2 Testing

Offshore Area

Testing activities using seafloor devices would increase within established ranges and testing locations as compared with the No Action Alternative and Alternative 1 (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, it would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities using seafloor devices in Alternative 2 would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

Inland Waters

Testing activities using seafloor devices would increase within established ranges and testing locations as compared with the No Action Alternative and Alternative 1 (see Table 3.11-1). Although Native American subsistence and commercial fishing equipment could be damaged by activities using seafloor devices, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from an increase in testing activities using seafloor devices in Alternative 2 would occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

Western Behm Canal, Alaska

The Western Behm Canal is within the Ketchikan Nonsubsistence Use Area (Alaska Department of Fish and Game 2011), which precludes subsistence uses of resources in the Western Behm Canal. Because the Western Behm Canal does not contain any Alaska Native protected tribal resources or other traditional resources or fishing areas, no impact on Alaska Native protected tribal resources or other traditional resources would occur as a result of testing activities using seafloor devices.

No impacts on Native American protected tribal resources or other traditional resources would occur under Alternative 2; however, loss or damage to Native American fishing equipment from the use of seafloor devices during testing activities could occur. A system for filing damage claims against the Navy exists, and obtaining reimbursement may be possible in certain circumstances.

3.11.3.3.5 Impacts from Military Expended Materials

Military expended materials can physically interact with Native American fishing equipment. Almost all training and testing activities produce military expended materials such as chaff, flares, projectiles, casings, target fragments, missile fragments, rocket fragments, decelerator/parachutes, and ballast weights. A remote chance exists that Native American fishermen using nets could recover military expended materials. No military expended materials would be associated with activities at SEAFAC.

3.11.3.3.6 No Action Alternative

3.11.3.3.6.1 Training

Offshore Area

Under the No Action Alternative, training activities resulting in the deposition of military expended materials would continue at current levels and within established ranges and training locations (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

Inland Waters

Under the No Action Alternative, training activities resulting in the deposition of military expended materials would continue at current levels and within established ranges and training locations (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

3.11.3.3.6.2 Testing

Offshore Area

Under the No Action Alternative, testing activities resulting in the deposition of military expended materials would continue at current levels and within established ranges and testing locations (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal

resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

Inland Waters

Under the No Action Alternative, testing activities resulting in the deposition of military expended materials would continue at current levels and within established ranges and testing locations (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

Western Behm Canal, Alaska

No testing activities resulting in the deposition of military expended materials occur in the Western Behm Canal (see Table 3.11-1). No impacts on Alaska Native protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in the No Action Alternative would occur.

3.11.3.3.7 Alternative 1

3.11.3.3.7.1 Training

Offshore Area

Training activities resulting in the deposition of military expended materials would continue, decreasing in frequency for some activities and introducing new activities within the Study Area as compared with the No Action Alternative (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 1 training activities resulting in the deposition of military expended materials would occur.

Inland Waters

Training activities resulting in the deposition of military expended materials would continue, increasing in frequency for some activities and introducing new activities within the Study Area as compared with the No Action Alternative (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, these training activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or

other traditional resources from Alternative 1 training activities resulting in the deposition of military expended materials are anticipated.

Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities resulting in the deposition of military expended materials in Alternative 1 would occur.

3.11.3.3.7.2 Testing

Offshore Area

Testing activities resulting in the deposition of military expended materials would increase within established ranges and testing locations as compared with the No Action Alternative (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 1 testing activities resulting in the deposition of military expended materials are anticipated.

Inland Waters

Testing activities resulting in the deposition of military expended materials would increase within established ranges and testing locations as compared with the No Action Alternative (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 1 testing activities resulting in the deposition of military expended materials are anticipated.

Western Behm Canal, Alaska

No testing activities resulting in the deposition of military expended materials occur in the Western Behm Canal (see Table 3.11-1). No impacts on Alaska Native protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in Alternative 1 would occur.

Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in Alternative 1 would occur.

3.11.3.3.8 Alternative 2

3.11.3.3.8.1 Training

Offshore Area

Training activities resulting in the deposition of military expended materials would continue, decreasing in frequency for some activities and introducing new activities within the Study Area as compared with the No Action Alternative and would be the same as Alternative 1 (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial

fishing equipment, these training activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 2 training activities resulting in the deposition of military expended materials would occur.

Inland Waters

Training activities resulting in the deposition of military expended materials would continue, increasing in frequency for some activities and introducing new activities within the Study Area as compared with the No Action Alternative but matching the number of activities in Alternative 1 (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, these training activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 2 training activities resulting in the deposition of military expended materials are anticipated.

Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from training activities resulting in the deposition of military expended materials in Alternative 2 would occur.

3.11.3.3.8.2 Testing

Offshore Area

Testing activities resulting in the deposition of military expended materials would increase within established ranges and testing locations as compared with the No Action Alternative and Alternative 1 (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources traditional resources from Alternative 2 testing activities resulting in the deposition of military expended materials are anticipated.

Inland Waters

Testing activities resulting in the deposition of military expended materials would increase within established ranges and testing locations as compared with the No Action Alternative and Alternative 1 (see Table 3.11-1). Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, these testing activities would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from Alternative 2 testing activities resulting in the deposition of military expended materials are anticipated.

Western Behm Canal, Alaska

No testing activities resulting in the deposition of military expended materials occur in the Western Behm Canal (see Table 3.11-1). No impacts on Alaska Native protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in Alternative 2 would occur.

Although military expended materials could be inadvertently retrieved by Native American subsistence and commercial fishing equipment, such retrieval would not affect protected tribal resources or other traditional resources or the use of the usual and accustomed fishing grounds. No impacts on Native American protected tribal resources or other traditional resources from testing activities resulting in the deposition of military expended materials in Alternative 2 would occur.

3.11.3.4 Secondary Impacts

Socioeconomics could be impacted if proposed activities led to changes to physical and biological resources to the extent that they would alter the way industries can use those resources. The secondary impacts on marine resource availability pertains to the potential for loss of fisheries resources within the Study Area.

Native American and Alaska Native protected tribal resources and other traditional resources such as use of usual and accustomed fishing areas could be impacted if proposed activities altered fish and other marine species population levels to such an extent that these tribes could no longer find their target species. Analyses in Sections 3.4 (Marine Mammals), 3.8 (Marine Invertebrates), and 3.9 (Fish) conclude that impacts on marine species to the extent cited above from training and testing activities would not occur. Based on these conclusions, secondary impacts on Native American and Alaska Native protected tribal resources and other traditional resources would not occur.

3.11.3.5 Summary of Potential Impacts of All Stressors on Native American and Alaska Native Traditional Resources

Stressors described in this EIS/OEIS would not result in potential impacts on Native American and Alaska Native traditional resources under the No Action Alternative, Alternative 1, or Alternative 2 in accordance with Section 106 of the National Historic Preservation Act. No traditional resources have been identified in the Study Area (Table 3.11-2).

Table 3.11-2: Summary of Effects of Training and Testing Activities on Native American and Alaska Native Traditional Resources

Alternative and Stressor	Effects of Training and Testing Activities
No Action Alternative	
Acoustic Stressors	Airborne acoustics during training and testing activities would not affect traditional resources within United States (U.S.) territorial waters because no traditional resources have been identified in the Study Area.
Physical Stressors	Physical stressors resulting from use of seafloor devices and deposition of expended materials would not affect traditional resources within U.S. territorial waters because no traditional resources have been identified in the Study Area.
Alternative 1 (Preferred Alternative)	
Acoustic Stressors	Airborne acoustics during training and testing activities would not affect traditional resources within U.S. territorial waters because no traditional resources have been identified in the Study Area.
Physical Stressors	Physical stressors resulting from use of seafloor devices and deposition of expended materials during training and testing activities would not affect traditional resources within U.S. territorial waters because no traditional resources have been identified in the Study Area.
Regulatory Determination	Alternative 1 increases the number of training and testing activities and introduces these activities in additional areas. Acoustic and physical stressors, as indicated above, would not affect traditional resources within United States territorial waters.
Alternative 2	
Acoustic Stressors	Airborne acoustics during training and testing activities would not affect traditional cultural properties within U.S. territorial waters because no traditional resources have been identified in the Study Area.
Physical Stressors	Physical stressors resulting from use of seafloor devices and deposition of expended materials during training and testing activities would not affect traditional resources within U.S. territorial waters because no traditional resources have been identified in the Study Area.
Regulatory Determination	Alternative 2 increases the number of training and testing activities and introduces these activities in additional areas. Acoustic and physical stressors, as indicated above, would not affect traditional resources within United States territorial waters.

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3.12 Socioeconomic Resources

TABLE OF CONTENTS

3.12 SOCIOECONOMIC RESOURCES 3.12-1
3.12.1 INTRODUCTION AND METHODS 3.12-1
3.12.2 AFFECTED ENVIRONMENT 3.12-2
3.12.2.1 Transportation and Shipping 3.12-3
3.12.2.2 Commercial and Recreational Fishing 3.12-9
3.12.2.3 Tourism 3.12-13
3.12.3 ENVIRONMENTAL CONSEQUENCES 3.12-16
3.12.3.1 Accessibility 3.12-18
3.12.3.2 Physical Disturbance and Interactions 3.12-24
3.12.3.3 Airborne Acoustics 3.12-30
3.12.3.4 Secondary Impacts 3.12-34
3.12.3.5 Summary of Potential Impacts of All Stressors on Socioeconomic Resources 3.12-34

LIST OF TABLES

TABLE 3.12-1: ANNUAL COMMERCIALLY LANDED CATCH AND VALUE WITHIN WASHINGTON WATERS (2011) 3.12-10
TABLE 3.12-2: RECREATIONAL SPORTFISHING CATCH FOR 2007–2008 ..... 3.12-13
TABLE 3.12-3: STRESSOR TABLE FOR SOCIOECONOMIC RESOURCES 3.12-18

LIST OF FIGURES

FIGURE 3.12-1: SHIPPING ROUTES IN PACIFIC NORTHWEST UNITED STATES 3.12-5
FIGURE 3.12-2: COMMERCIAL AIR ROUTES IN PACIFIC NORTHWEST UNITED STATES 3.12-8
FIGURE 3.12-3: RECREATIONAL AREAS IN PUGET SOUND 3.12-15

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3.12 SOCIOECONOMIC RESOURCES

SOCIOECONOMIC RESOURCES SYNOPSIS

The United States Department of the Navy (Navy) considered all potential stressors, and the following have been analyzed for socioeconomic resources:

- Accessibility (limiting access to the ocean and the air)
- Physical Disturbance and Interactions (aircraft, vessels and in-water devices, military expended materials)
- Airborne Acoustics (weapons firing, aircraft and vessel noise)
- Secondary Impacts (from changes to the availability of marine resources)

Preferred Alternative (Alternative 1)

- Impacts on socioeconomic resources are not expected because inaccessibility to areas of co-use would be localized and temporary, the Navy's strict standard operating procedures would minimize physical disturbance and interactions, the majority of airborne activities would occur well out to sea far from tourism and recreation locations, and impacts on marine species are not expected. Further, there are no disproportionately high impacts or adverse effects on any low-income or minority populations.

3.12.1 INTRODUCTION AND METHODS

This section provides an overview of the characteristics of socioeconomic resources in the Northwest Training and Testing (NWTT) Study Area (hereafter referred to as the Study Area) and describes, in general terms, the methods used to analyze the Proposed Action's potential impacts on these resources.

The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) state that when economic or social effects and natural or physical environmental effects are interrelated, the environmental impact statement will discuss these effects on the human environment (40 Code of Federal Regulations [C.F.R.] 1508.14). The CEQ regulations state that the "human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." To the extent that the ongoing and proposed United States (U.S.) Department of the Navy (Navy) training and testing activities in the Study Area could affect the natural or physical environment, the socioeconomic analysis evaluates how elements of the human environment might be affected. The Navy identified three broad socioeconomic topics based on their association with human activities and livelihoods in the Study Area. Each of these socioeconomic resources is an aspect of the human environment that involves economics (e.g., employment, income, or revenue) and social conditions (e.g., enjoyment and quality of life) associated with the marine environment of the Study Area. Therefore, this evaluation considered potential impacts on the following three socioeconomic activities:

- Commercial transportation and shipping
- Commercial and recreational fishing (usual and accustomed fishing by Pacific Northwest Native American tribes and Alaska Natives is analyzed in Section 3.11, Native American and Alaska Native Traditional Resources)
- Tourism

The baseline for identifying the socioeconomic conditions in the Study Area was derived using relevant published information from sources that included federal, state, regional, and local government agencies and databases, academic institutions, conservation organizations, technical and professional organizations, and private groups. Previous environmental studies were also reviewed for relevant information.

The alternatives were evaluated based on the potential for and the degree to which training and testing activities could impact socioeconomic resources. The potential for impacts depends on the likelihood that the training and testing activities would interact with public activities or infrastructure. Factors considered in the analysis include whether there would be temporal or spatial interfaces between the public or infrastructure and Navy training and testing. If there is potential for this interaction, factors considered to estimate the degree to which an exposure could impact socioeconomic resources include whether there could be an impact on livelihood, quality of experience, resource availability, income, or employment. If there is no expected potential for the public to interface with an activity, the impacts would be considered negligible.

The alternatives were also reviewed for any disproportionately high and adverse effects on any low-income or minority populations in accordance with Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. This EO requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. The CEQ has emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under NEPA and of developing protective measures that avoid disproportionate environmental effects on minority and low-income populations.

3.12.2 AFFECTED ENVIRONMENT

The area of interest for assessing potential impacts on socioeconomic resources is composed of established military operations areas (MOAs) and warning areas in the eastern North Pacific Ocean region, adjacent to the Northwest coast of the United States (California, Oregon, and Washington), including the Strait of Juan de Fuca, Puget Sound (Washington state Inland Waters), and Western Behm Canal in southeastern Alaska (see Figure 2.1-1). In addition, the Study Area includes Navy piers at Naval Base (NAVBASE) Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett. The area of interest for the environmental justice review associated with EO 12898 are the low-income and minority populations adjacent to the Study Area. This section describes the three socioeconomic resources (transportation and shipping, commercial and recreational fishing, and tourism) associated with human activities and livelihoods in the Study Area from shore seaward out to 12 nautical miles (nm) consistent with NEPA.

Areas of surface water within the Study Area may be designated as restricted areas, as described in the C.F.R., Title 33 (Navigation and Navigable Waters), Part 334 (Danger Zone and Restricted Area Regulations) and established by the U.S. Army Corps of Engineers. A restricted area is designated to prohibit or limit public access to an area. Restricted areas generally provide security for government property and protection of the public from risks of damage or injury arising from government activities in the area (33 C.F.R. 334.2). Restricted areas within 12 nm of shore in the Study Area have the potential to impact the three socioeconomic resources identified above.

All of the training and testing activities proposed in this Environmental Impact Statement (EIS)/Overseas EIS (OEIS) would occur in one or more of these three range subdivisions:

- Offshore Area (Pacific Northwest Operating Area [OPAREA], including the surf zone at Pacific Beach)
- Inland Waters (Washington state inland waters)
- Western Behm Canal (Southeast Alaska Acoustic Measurement Facility [SEAFAC])

The Offshore Area includes air, surface, and subsurface OPAREAs extending generally west from the coastline of Washington, Oregon, and Northern California for about 250 nm into international waters. In Washington, the eastern boundary of the Offshore Area abuts the coastline for 1 mile (mi.) of surf zone at Pacific Beach; while in Oregon and Northern California, the boundary lies 12 nm off the coastline. The Offshore Area also includes the Quinault Range Site. Further description of the Offshore Area can be found in Section 2.1.1 (Description of the Offshore Area).

The Inland Waters include air, sea, and undersea space inland of the coastline and eastward to include all waters of the Strait of Juan de Fuca, the Puget Sound, and the Strait of Georgia. None of this area extends into Oregon or California. Further description of the Inland Waters can be found in Section 2.1.2 (Description of the Inland Waters).

SEAFAC consists of three major functional components: (1) Back Island Operations Center and supporting facilities, (2) Underway Measurement Site, and (3) Static Site (see Figure 2.1-4). The three major functional components are within the five restricted areas in Western Behm Canal. The main purposes of the restricted areas are to lessen acoustic encroachment from nonparticipating vessels and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. The perimeter of Restricted Area 5 constitutes the Study Area boundary, and the Study Area does not include land-based supporting facilities or operations. The sensors at SEAFAC are passive and measure radiated noise in the water, such as machinery on submarines and other underwater vessels. SEAFAC does not use tactical mid-frequency active sonar (sound navigation and ranging). Active acoustic sources are used for communications and range calibration, and to provide position information for units operating submerged on the range. Further description of the Western Behm Canal can be found in Section 2.1.3 (Description of the Western Behm Canal, Alaska).

3.12.2.1 Transportation and Shipping

The Study Area is used by the military and civilians for a broad spectrum of activities. The Navy conducts training and testing activities in areas where commercial transportation and shipping occurs. Notifications of potentially hazardous operations are communicated to all vessels and operators by use of Notices to Mariners (NTMs), issued by the U.S. Coast Guard, and Notices to Airmen (NOTAMs), issued by the Federal Aviation Administration. The Department of Defense also publishes separate NOTAMs about runway closures, missile launches, special traffic management procedures, and malfunction of navigational aids.

3.12.2.1.1 Commercial Shipping

Ocean shipping is a significant component of the regional economy. Washington State handles 7 percent of the country's exports and 6 percent of its imports. The maritime Port of Seattle was the nation's 11th-busiest waterborne freight gateway for international merchandise trade by value of shipments in 2008. More than 1,000 vessels called at the Port of Seattle in 2008 (U.S. Department of Transportation 2009). Container vessels made the most calls at the port, accounting for 64 percent, while 28 percent of

the calls were by dry-bulk ships. Seattle and Tacoma were ranked 7th and 11th, respectively, among U.S. ports for total cargo imported and exported in 2011. Taken together, these two ports make up the nation's fourth-largest container load center in the United States (American Association of Port Authorities 2012). Other key ports in the region include:

- Bellingham (Whatcom County, Washington)
- Orcas, Friday Harbor, and Lopez (San Juan County, Washington)
- Anacortes and Skagit County (Skagit County, Washington)
- Coupeville and South Whidbey Island (Island County, Washington)
- Port Angeles (Clallam County, Washington)
- Port Townsend (Jefferson County, Washington)
- Everett and Edmonds (Snohomish County, Washington)
- Olympia (Thurston County, Washington)
- Shelton, Allyn, Grapeview, Dewatto, and Hoodsport (Mason County, Washington)
- Kingston, Indianola, Keyport, Poulsbo, Brownsville, Tracyton, Waterman, Bremerton, Silverdale, and Manchester (Kitsap County, Washington)
- Grays Harbor (Grays Harbor County, Washington)
- Port of Astoria (Clatsup County, Oregon)
- Port of Newport (Lincoln County, Oregon)
- Coos Bay (Coos County, Oregon)
- Port Orford (Curry County, Oregon)
- Eureka (Humboldt County, California)

3.12.2.1.1.1 Offshore Area

Ocean traffic is the transit of commercial, private, or military vessels at sea, including submarines. The ocean traffic flow in congested waters, especially near coastlines, is controlled by the use of directional shipping lanes for large vessels, including cargo, container ships, and tankers. Traffic flow controls are also implemented to ensure that harbors and ports of entry remain as uncongested as possible. There is less control on open-ocean traffic involving recreational boating, sport fishing, commercial fishing, and activity by naval vessels. In most cases, the factors that govern shipping or boating traffic include adequate depth of water, weather conditions (primarily affecting recreational vessels), availability of fish and other marine resources, and temperature.

Most vessels entering or leaving the Washington ports travel northwest, southwest, or south through the Study Area, particularly the Pacific Northwest OPAREA, without incident or delay. Shipping to and from the south typically follows the coastline of Washington, Oregon, and California. Ships traveling between Washington ports, Hawaii, and the Far East travel via the most direct route or great circle route (Figure 3.12-1).

3.12.2.1.1.2 Inland Waters

The Keyport Range Site, Dabob Bay Range Complex (DBRC) Site, Carr Inlet OPAREA, Navy 3 and Navy 7 OPAREAs, and pierside locations are all within Inland Waters of Washington State. The Keyport Range Site is charted on navigational charts as a restricted area. Although it is not a restricted area, the Navy limits or restricts access into Crescent Harbor as a safety protocol when mine warfare training is being conducted. Access to pierside locations is also restricted at all times.

Figure 3.12-1: Shipping Routes in Pacific Northwest United States

Navigational obstructions may occur in a small portion of Keyport Range Site tests; in these cases (as for current activities), an NTM is issued. In addition, the U.S. Coast Guard has published a final rule establishing protection zones extending 500 yards (yd.) (457 meters [m]) around all Navy vessels in navigable waters of the United States and within the boundaries of Coast Guard Pacific Area (32 C.F.R. Part 761). All vessels must proceed at a no-wake speed when within a protection zone. Nonmilitary vessels are not permitted to enter within 100 yd. (91 m) of a U.S. naval vessel, whether underway or moored, unless authorized by an official patrol.

The DBRC Site contains Dabob Bay and Hood Canal MOAs, which are charted as naval OPAREAs on navigational charts. During any activities within Dabob Bay, the NUWC Keyport-maintained yellow, white, and red warning lights at Sylopash Point, Pulali Point, Whitney Point, Zelatched Point, and the southeast end of Bolton Peninsula warn nonmilitary craft of the status of range use. Descriptions of these lights are posted at local boat ramps and marinas. Yellow or alternating white and yellow lights indicate to nonmilitary vessels that (1) they should proceed with caution; (2) range activities are in progress, but no noise-sensitive acoustic measurement tests are in progress; or (3) vessels should be prepared to shut down engines when lights change to red. Red or alternating white and red lights indicate (1) range activities involving critical measurements are in progress; (2) engines should be stopped until red beacons have been shut off, indicating the test is completed; and (3) advice of Navy personnel on guard boats should be followed when in or near the range site. Typically, boat passage is permitted between tests when the yellow beacons are operating.

The Carr Inlet OPAREA contains a restricted area (33 C.F.R. 334.1250); it was once used as an acoustic range but has been inactive since 2008. No special use airspace is associated with the Carr Inlet OPAREA.

Pierside sonar maintenance testing within the Study Area is conducted within the Puget Sound at NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor Waterfront, and Naval Station Everett. Activities at these pierside locations (Bremerton, Bangor, and Everett) are conducted in the established waterfront restricted areas for those installations.

3.12.2.1.1.3 Western Behm Canal, Alaska

Western Behm Canal includes five restricted areas (see Figure 2.1-4). During operations, the Navy can close the restricted area to all vessel traffic, although normally such closures will not exceed 20 minutes. Small craft may operate within 500 yd. (457 m) of the shoreline at speeds no greater than 5 knots during closures. The purpose of these transitory restrictions is to minimize ambient underwater sound levels to ensure integrity of the testing for accomplishing SEAFAC's mission; these restrictions also help protect public safety during testing. On average, 10 transitory restrictions occur annually for a total of 40 days per year. In some restricted areas, no vessel may anchor, tow a drag of any kind, deploy a net, or dump any material at any time.

From May 1 through September 15 annually, the Navy conducts acoustic measurement tests that will result in only transitory restrictions in Area 5 (see Figure 2.1-4) for a total of no more than 15 days. This falls within the cruise ship season, when visitation and recreational use of Western Behm Canal is highest and when vessel traffic associated with commercial fishing is most likely. This provision ensures that at least 89 percent of the days during this important time would be free of transit restrictions.

Public notification that the Navy will conduct operations in Western Behm Canal is given at least 72 hours in advance to the following Ketchikan contacts: U.S. Coast Guard, Ketchikan Gateway Borough

Planning Department, Harbor Master, Alaska Department of Fish and Game, KRBD radio, KTKN radio, and the *Ketchikan Daily News*.

3.12.2.1.2 Air Traffic

Air traffic refers to movements of aircraft through airspace. Safety and security factors dictate that use of airspace and control of air traffic be closely regulated. Accordingly, regulations applicable to all aircraft are promulgated by the Federal Aviation Administration to define permissible uses of designated airspace and to control that use. These regulations are intended to accommodate the various categories of aviation, whether military, commercial, or general. Common air routes over the Study Area are depicted in Figure 3.12-2.

The system of airspace designation uses various definitions and classifications to facilitate control. Airspace is categorized generally as either "controlled" or "uncontrolled." Controlled airspace is further organized into several different classes distinguished by altitude, range, use (e.g., commercial or military), and proximity to a major airport. Controlled airspace means that services supporting aircraft flying under instrument flight rules are available. Such services include air-to-ground radio communication, navigational aids, and air traffic control services for maintaining separation between aircraft. Controlled airspace does not mean that all flights are controlled by air traffic control.

Special use airspace consists of both controlled and uncontrolled airspace and has defined dimensions where flight and other activities are confined because of their nature and the need to restrict or prohibit nonparticipating aircraft for safety reasons. Special use airspace is established under procedures outlined in 14 C.F.R. Part 73 The primary purpose of special use airspace is to establish or designate airspace in the interest of national defense, security and/or welfare. Restricted areas, warning areas, and MOAs are used for military training. One type of special use airspace of particular relevance to the Study Area is a warning area, defined in 14 C.F.R. Part 1 as follows:

> "A warning area is airspace of defined dimensions, extending from 3 nm outward from the coast of the United States that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both."

A restricted area is airspace designated under 14 C.F.R. Part 73 within which the flight of aircraft, while not wholly prohibited, is subject to restriction. The military returns special use airspace to the Federal Aviation Administration when the airspace is not employed for its designated military use.

3.12.2.1.2.1 Offshore Area

Jet routes are the network of airways serving commercial aviation operations from flight level (FL) 180 up to but not including FL 450 (flight levels are the specified heights, in hundreds of feet above sea level). The routes in the Study Area are primarily managed by the Seattle Air Route Traffic Control Center. Victor routes are the network of airways serving commercial aviation operations up to but not including 18,000 feet (ft.) (5,486 m) above mean sea level (MSL). Seattle Terminal Radar Approach Control coordinates approach services for the Seattle-Tacoma International Airport and has over 450,000 operations per year for southern and central Puget Sound.

The special use airspace in the Offshore Area (Figure 3.12-2), included in this analysis, consists of

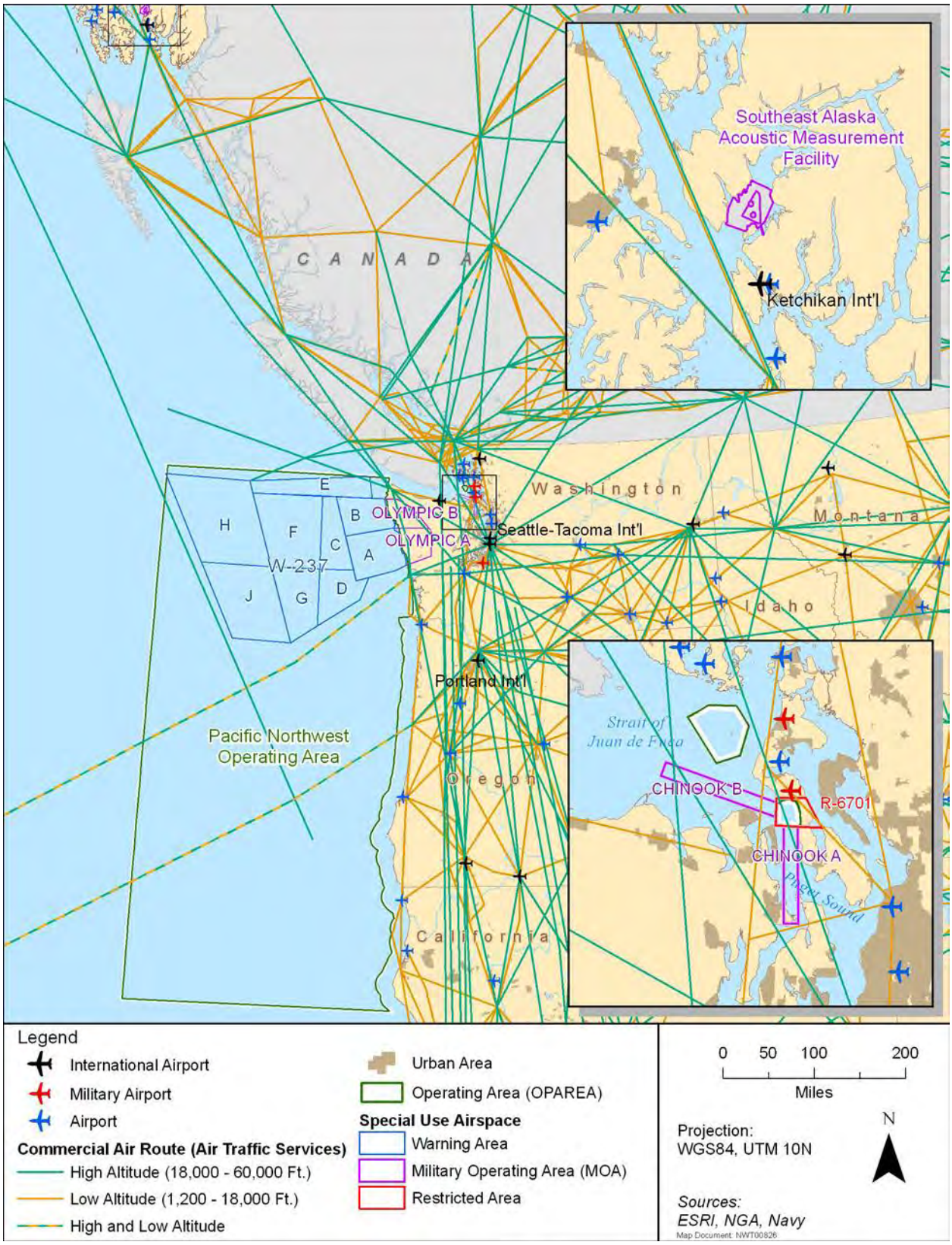

Figure 3.12-2: Commercial Air Routes in Pacific Northwest United States

Warning Area 237 (W-237) and the Olympic MOA. W-237 extends westward from the coast of Washington, covering 24,989 square nautical miles (nm^2).

The Olympic A and B MOAs are airspace over the Olympic Peninsula of the Washington coast encompassing 1,619 nm^2. Access restrictions are released to the aviation community through NOTAMs, published by local airports, and included on their Automated Terminal Information System broadcasts. Other special use airspace in the Northwest Training Range Complex (NWTRC) is covered by the NWTRC EIS/OEIS (U.S. Department of the Navy 2010a) and will not be addressed in this EIS/OEIS.

3.12.2.1.2.2 Inland Waters

The special use airspace in the Puget Sound portion of the Study Area (Figure 3.12-2), included in this analysis, consists of Restricted Area 6701 (R-6701) and Chinook MOAs. R-6701 is over Admiralty Bay and is activated when necessary to support safe range operations. Chinook A and B MOAs are approach corridors leading into R-6701; they cover 23 and 33 nm^2 of airspace, respectively. Access restrictions are released to the aviation community through NOTAMs, published by local airports, and included on their Automated Terminal Information System broadcasts. Other special use airspace in the NWTRC is covered by the NWTRC EIS/OEIS (U.S. Department of the Navy 2010a) and will not be addressed in this EIS/OEIS.

3.12.2.1.2.3 Western Behm Canal, Alaska

Controlled airspace similar to a temporary flight restriction exists over the SEAFAC area in Western Behm Canal during acoustic trials. The restriction is released to the aviation community through a NOTAM, published by local airports, and included on their Automated Terminal Information System broadcast. The temporary flight restriction extends up to 3,000 ft. (914 m) and has a radius of 1 nm. It is intended to keep floatplanes with tourists or fishermen at a distance when SEAFAC is conducting acoustic tests.

3.12.2.2 Commercial and Recreational Fishing

3.12.2.2.1 Offshore Area

The commercial fishing sector provides approximately 10,000 jobs in the greater Seattle area and accounts for gross annual sales of more than $3.5 billion (Washington State 2007). Recreational fishing is extremely limited due to the distance from shore and the capabilities of recreational fishing vessels. Less than 10 percent of recreational fishing takes place in federal waters, which are beyond 3 nm from shore. Commercial fishing gear used in the Study Area includes drift gillnets, longline gear, troll gear, trawls, seining, and traps or pots. The National Marine Fisheries Service (NMFS) has reported commercial fishing landings in Washington State of over 210 million pounds of fish and shellfish in 2011, worth over $329 million (National Marine Fisheries Service 2013).

Commercial fishing takes place throughout the Offshore Area, from nearshore waters adjacent to the mainland to the offshore fishing grounds. The Pacific Fishery Management Council is one of eight regional fishery management councils established by the Magnuson Fishery Conservation and Management Act of 1976 to manage fisheries of the U.S. coastline (including the coasts of California, Oregon, and Washington). The council has defined four main fisheries: groundfish (e.g., flounder, sole), highly migratory species (e.g., tuna), coastal pelagic species (e.g., anchovy, mackerel, herring, sardines), and salmon. Pacific Fisheries Information Network maintains commercial catch block data for ocean areas off the coasts of Washington, Oregon, California, Alaska, and British Columbia. For 2011, the most

commonly harvested commercial species in Washington State waters were groundfish species, tuna (albacore), crab, and salmon (Pacific Fisheries Information Network 2012) (Table 3.12-1).

Table 3.12-1: Annual Commercially Landed Catch and Value within Washington Waters (2011)

PFMC-Managed Species by Management Plan	RWT-MTONS	Revenue
Coastal Pelagic Species		
Northern anchovy	191.0	$68,129
Pacific herring	217.2	$169,353
Total	**408.2**	**$237,482**
Crab		
Dungeness crab	12,307.0	$83,582,330
Total	**12,307.0**	**$83,582,330**
Pacific Coast Groundfish Species		
Arrowtooth flounder	568.8	$129,470
Dover sole	660.0	$500,424
English sole	64.9	$49,101
Lingcod	149.7	$259,674
Pacific cod	353.8	$393,122
Pacific whiting	34,481.0	$7,190,224
Petrale sole	234.0	$707,929
Rex sole	43.0	$33,046
Rock sole	3.7	$2,889
Rockfish	1,071.5	$1,190,485
Sablefish	1,556.1	$12,439,343
Spiny dogfish	214.0	$140,125
Starry flounder	31.4	$23,796
Unspecified flatfish	1.2	$810
Unspecified sanddabs	26.3	$20,947
Unspecified skate	44.3	$20,128
Walleye pollock	1.1	$381
Total	**39,504.8**	**$23,101,894**
Highly Migratory Species		
Albacore tuna	6,012.4	$22,244,246
Total	**6,012.4**	**$22,244,246**
Other		
Miscellaneous fish/animals	6.2	$1,471
Sea urchins	52.7	$119,347
Pacific halibut	588.1	$6,503,204
Red sea urchin	32.4	$48,212
Unspecified octopus	1.6	$2,537
Unspecified sea cucumbers	418.4	$3,869,702
Unspecified shark	1.7	$0
Unspecified melt	37.5	$42,903
Unspecified squid	2.6	$280

Table 3.12-1: Annual Commercially Landed Catch and Value within Washington Waters (2011) (continued)

PFMC-Managed Species by Management Plan	RWT-MTONS	Revenue
Other (continued)		
Unspecified hagfish	700.8	$1,299,501
Unspecified shad	8.0	$3,888
White sturgeon	62.4	$333,226
Total	**1,912.4**	**$12,217,278**
Pacific Salmon Species		
Chinook salmon	2,494.5	$13,366,085
Chinook roe	0.5	$4,467
Chum salmon	3,843.1	$9,997,926
Chum roe	0.3	$2,199
Coho salmon	1,142.6	$3,878,366
Coho roe	0.9	$7,994
Pink salmon	8633.0	$9,077,354
Sockeye salmon	816.9	$3,040,523
Steelhead salmon	188.8	$882,081
Total	**17,704.5**	**$42,428,279**
Shrimp		
Other shrimp	37.9	$99,394
Pink shrimp	4,342.4	$4,610,336
Spotted prawn	192.1	$2,293,275
Unspecified bait shrimp	57.0	$152,593
Total	**4,629.4**	**$7,155,598**
Other Species[1]		
Other species	16,572.0	$100,049,385
Total	**16,572.0**	**$100,049,385**
Grand total	**99,248.0**	**$291,015,131**

[1] Other Species category includes species not displayable in this report because of confidentiality restrictions.
Notes: PFMC = Pacific Fishery Management Council; RWT-MTONS = round metric weight equivalent in metric tons
Source: Pacific Fishery Management Council 2012

Within the Offshore Area, groundfish species make up most of the commercial catch. In 2011, groundfish accounted for 49 percent and salmon accounted for 18 percent of the commercial harvest. The overall 2011 annual catch in Washington State totaled 99,248 metric tons, worth $291,015,131 (Pacific Fisheries Information Network 2012).

In 2006, the NMFS completed an assessment for the Pacific Fishery Management Council of West Coast fishing communities for their engagement in and dependence on commercial and recreational fisheries income, as well as their resilience and vulnerability to changes in income from those fisheries (Pacific Fishery Management Council 2006). Based on this assessment, the communities that access fishery resources within the Offshore Area tend to have small populations, are geographically isolated, and are heavily dependent on tourism and natural resource extraction industries, including fishing.

Of the commercial fishing communities most dependent on fishing income, the following communities heavily depend on the groundfish resource and support fishing fleets that may access waters within the Study Area: Astoria, Oregon; Bellingham, Washington; Brookings, Oregon; Coos Bay, Oregon; Newport, Oregon; and Port Orford, Oregon. In addition, the Oregon ports of Newport, Garibaldi, Brookings, and Charleston are the most heavily engaged Northwest ports in chartered recreational fishing. The west coast's five fishing communities, least economically resilient to change in access to commercial and recreational fishery resources, all depend on income from fishery resources within the Offshore Area: Netarts and Copalis Beach, Oregon; Neah Bay and La Push, Washington; and Moss Landing, California. Three of the four least resilient west coast fishing counties also depend on income from fishery resources within the Offshore Area: Hood River and Lincoln Counties, Oregon, and Grays Harbor County, Washington. Additionally, the NMFS assessment characterized Ilwaco, Washington, as one of the west coast's two "most vulnerable" communities to changes in engagement in commercial fishing activities, meaning that it scored highest in terms of its engagement in and dependence on fishing income and lowest in terms of its resilience to economic change. Although these communities are not in the Study Area, they could potentially be affected by the Proposed Action because they fish in the Study Area.

3.12.2.2.2 Inland Waters

Few commercial fisheries remain in Puget Sound because of overfishing and urbanization and, as a result, the Puget Sound-based fishing fleets depend largely on offshore saltwater resources (Sommers and Canzoneri 1996). Puget Sound supports several industry sectors that are integrally linked to the marine environment. These include commercial fishing, sportfishing, and recreational activities that involve sailing and power boating. Washington's commercial fishing industry is the second-largest seafood producer in the United States following Alaska; Washington fishermen catch more than 60 percent of the edible seafood harvested in the United States (Washington State Department of Commerce 2012). The state is the largest producer of farmed shellfish in the nation and is a leading producer of naturally growing shellfish, most of which come from Puget Sound. Salmon also support a variety of fisheries in the Puget Sound region. These include sport, commercial, and tribal usual and accustomed fisheries (Pacific Fishery Management Council 2012). Commercial and tribal usual and accustomed fisheries are conducted with purse seine or gill nets, primarily in the open waterways of Puget Sound and Hood Canal (Washington Department of Fish and Wildlife 2012a). Native American and Alaska Native tribal and subsistence fishing is analyzed in Section 3.11 (Native American and Alaska Native Traditional Resources).

Commercial geoduck clam (*Panopea generosa*) harvest is managed by the Washington Department of Fish and Wildlife (Washington Department Fish and Wildlife 2012b). Geoduck harvest areas occur throughout the Puget Sound on soft bottom substrates. The Pacific Fishery Management Council has not reported geoduck harvests since 2007, but in that year, the harvest was valued at $28,000. Of the 2011 commercial catch of crustaceans, over 73 percent was attributable to Dungeness crabs (*Metacarcinus magister*) (about 12,307 metric tons). The remaining percent were various shrimp (4,629 metric tons). The catch of crustaceans was worth approximately $91,000,000 in 2011. In comparison, the annual catch of squid and octopus was worth $2,817; urchins were worth $167,559, and other invertebrates (e.g., snails, sea cucumbers) were worth approximately $3,869,702 (Table 3.12-1).

Recreational fishing typically occurs throughout the inlets of Puget Sound and Hood Canal. Recreational sportfishing in Puget Sound has been conservatively estimated to contribute $117 million per year to the regional economy (Washington Department of Ecology 2012). In 2004, an estimated 438,000 marine angler trips were taken (Kraig and Smith 2011) and over 175,000 pounds of fish (not counting shellfish) were caught by sportfishermen (Kraig and Smith 2011). In 2011, Washington State Department of Fish

and Wildlife published the catch totals for 2007–2008 recreational sportfishing, including steelhead, salmon, shellfish, and other marine fish (Table 3.12-2).

Table 3.12-2: Recreational Sportfishing Catch for 2007–2008

Sportfishing Activity	Total Pounds in 2007–2008	Total Number of Catches, 2007–2008
Sturgeon		17,962
Salmon		545,737
Steelhead		9,066
Marine fish		103,273
Oysters	483,816	
Clams	305,397	
Dungeness crab	1,141,977	

Source: Kraig 2011

3.12.2.2.3 Western Behm Canal, Alaska

Commercial fishing of salmon in the state waters near Ketchikan represents a large portion of the harvest for Ketchikan residents (Ketchikan Gateway Borough 2007). While hand and power-troll efforts for salmon harvest have declined, purse-seine and drift-gillnet efforts are stable in state waters. Other important commercial fisheries in the area include sea cucumber and sea urchin, herring spawn, and shrimp. The Ketchikan Coastal Management Program Plan (Ketchikan Gateway Borough 2007) identifies several open water areas near SEAFAC as heavy or moderate recreational fishing areas. These waters include portions of Behm Canal around Betton and Back Islands, Clover Passage, Clover Pass, Smuggler's Cove, and Helm Bay.

Navy activities that have the potential to conflict with other uses of Behm Canal, including commercial and recreational fishing, are minimized through specific provisions in 33 C.F.R. § 334, including short-duration closures and advanced public notification through NTMs. Navy activities have occurred in Behm Canal for approximately 20 years while minimizing conflicts with and impacts on other users.

3.12.2.3 Tourism

Coastal tourism and recreation can be defined as the full range of tourism, leisure, and recreation activities that take place in the coastal zone and the offshore coastal waters. These activities include coastal tourism development (e.g., hotels, resorts, restaurants, food industry, vacation homes, second homes) and the infrastructure supporting coastal development (e.g., retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, recreational fishing facilities). Also included is ecotourism (e.g., whale watching) and recreational activities such as recreational boating, cruises, swimming, recreational fishing, surfing, snorkeling, and self-contained underwater breathing apparatus (SCUBA) diving.

3.12.2.3.1 Offshore Area

Tourism within the Study Area occurs primarily within Puget Sound. Offshore tourism includes whale watching, which occurs March through November with peak tourism activity in the summer. Whale watching by boat primarily occurs along the Oregon coast (Newport and Depoe Bay) and Northern California (Ft. Bragg). Whale watching off the Washington coast occurs from boat- and land-based operations (O'Conner et al. 2009).

3.12.2.3.2 Inland Waters

Puget Sound is a body of water east of Admiralty Inlet through which ocean waters reach inland approximately 50 mi. (80 km) from the Pacific coast to provide all-weather ports for oceangoing ships at Seattle, Tacoma, and Olympia. The waterway is a complex and intricate system of channels, inlets, estuaries, embayments, and islands. Because of these beneficial waterways, the Puget Sound region is home to most Washington State citizens. An estimated 390,000 people participate in recreational activities in the waters and on the beaches of Puget Sound at least once a year (Washington Department of Ecology 2012). Most Puget Sound communities lie on either side of the north-south Interstate Highway 5 corridor that serves as the major traffic thoroughfare of the state.

Hood Canal is a natural glacier-carved fjord and the only true saltwater fjord in the lower United States; its clear deep waters provide world-class recreation opportunities. Dabob Bay is the largest of several internal bays of Hood Canal, which stretches more than 70 mi. (112 km) through Washington's pristine forestlands. Vendors along the shoreline offer a wide variety of boat rentals for recreational activities; services include recreational tours and group events. State parks on the shores of Hood Canal include Belfair, Twanoh, Potlatch, Triton Cove, Scenic Beach, Dosewallips, Kitsap Memorial, and Shine Tidelands (Figure 3.12-3). Hood Canal is a primary destination for tourism in south Puget Sound; camping is prevalent at private, national forest, and state park campgrounds. Near Carr Inlet, Penrose Point State Park provides camping on the shores of south Puget Sound.

The Olympic National Park and Olympic National Forest are adjacent to the Study Area. Tourism activities include, but are not limited to, backpacking, hiking, camping, fishing, flora gazing, horseback riding, mountaineering, photography, skiing, snowshoeing, stargazing, and wildlife watching. Almost three million people visited the area in 2010, and visitors contributed $103 million to the economy of the Olympic Peninsula (Stynes 2011).

The inland areas of Washington, many of which are adjacent to the Study Area, accommodate many outdoor activities, including backpacking, bird watching, boating, canoeing, fishing, golf, camping, hunting, kayaking, offroading, mountain biking, hiking and nature walks, swimming, tubing, and wildlife viewing and photography (U.S. Department of the Navy 2010a). Tourism is especially important for the towns of Coupeville and Langley, and Penn Cove Mussel Farm exports large quantities of its highly renowned Penn Cove Mussels. This aquaculture facility, along with many small farms, reflects the rural, agricultural nature of most of central Whidbey Island.

Sport fishing, sailing, power boating, kayaking, diving, whale watching, and other watersports are all activities popular in the Puget Sound marine areas (U.S. Department of the Navy 2010a). Recreational boating and ocean-related tourism activities contribute millions of dollars to the regional economy. Puget Sound has 244 marinas with 39,400 moorage slips and another 331 launch sites for smaller boats. Statewide, approximately 180,000 boats are registered, not counting thousands more small boats and watercraft that do not require registration. An estimated $464 million in combined boat, motor, and related purchases ranks Washington 10th highest in the nation for boating-related expenditures (Washington Department of Ecology 2012).

Areas that contribute to recreational activity within Puget Sound include Cama Beach and Camano Island State Parks on Camano Island; Ft. Worden, Miller Peninsula, Anderson Lake, Shine Tidelands, and Sequim Bay State Parks on the Olympic Peninsula; and Mystery Bay and Ft. Flagler State Parks on Indian Island. To the south, near the DBRC Site, the Kitsap Memorial State Park and other regional parks on the Kitsap peninsula also allow beach and water access (Figure 3.12-3). Puget Sound’s good underwater

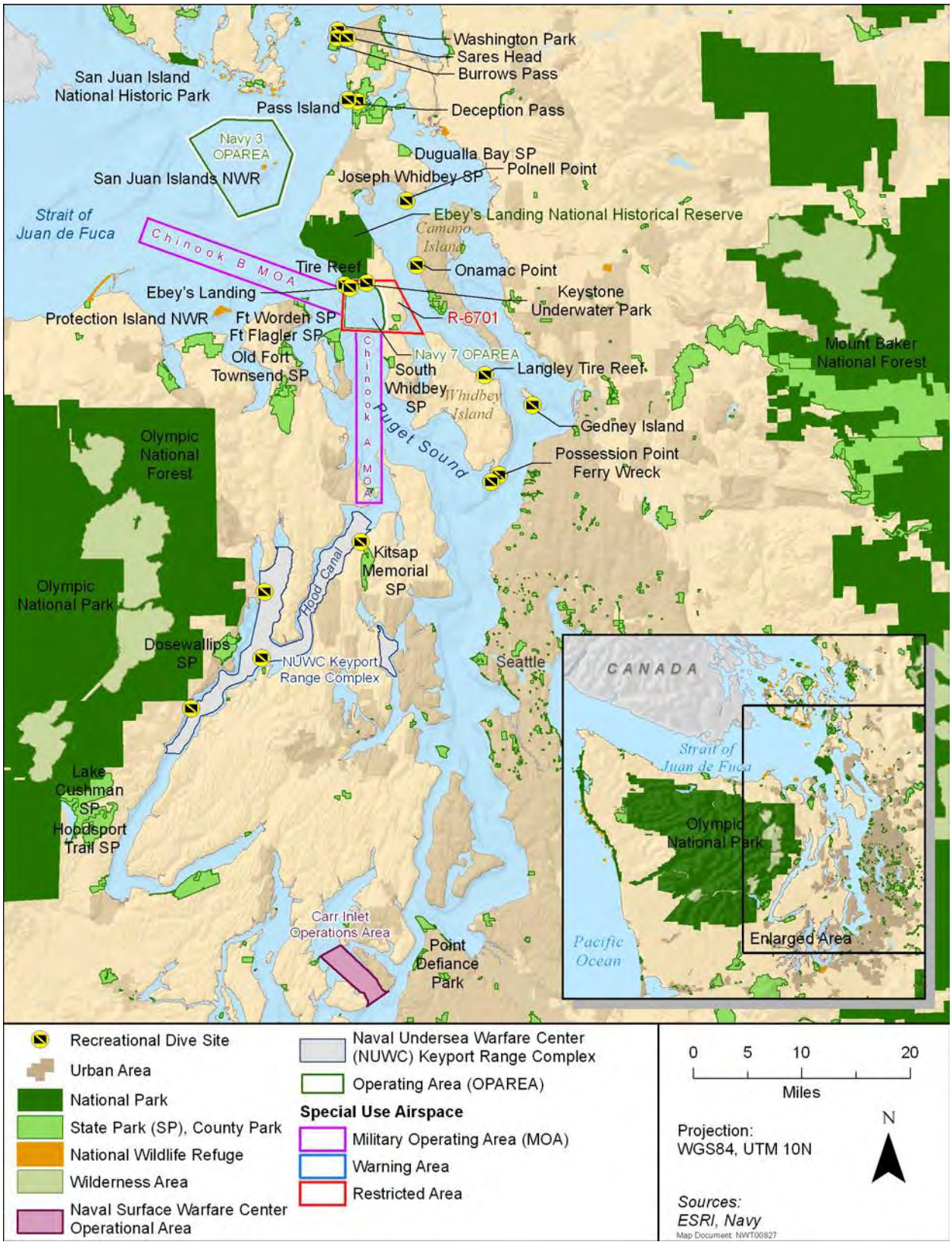

Figure 3.12-3: Recreational Areas in Puget Sound

visibility, rich sea life, and largely pristine diving conditions make it a popular destination for divers in the northwest. Charter dive trips to specific sites (Figure 3.12-3) are often published and booked as many as six months in advance. Most dive charters are scheduled for weekends. Diving occurs year-round, though the number of trips to popular dive sites peak during the summer. To facilitate such interests, many boat ramps have been placed in sheltered areas of the Puget Sound to allow access from different points around the bays, straights, and canals of the Study Area. These are maintained and controlled by the local, state, or federal ownership of the location. Boat licenses are controlled by the state, and permits for launching are controlled by the jurisdiction where the site is located. These launch points see increased activity on the weekends and during the summer.

3.12.2.3.3 Western Behm Canal, Alaska

In general, tourism has increased in Southeast Alaska in the last two decades, but statewide declines were observed in 2009 (McDowell Group 2010). Tourism generates substantial income for Ketchikan and creates employment in a variety of industries, such as transportation, retail trade, and services. Many of the visitors to Ketchikan arrive via cruise ship. Eleven cruise lines provide approximately 20 cruise ships per week to dock in Ketchikan from May through September 2012 (Experience Ketchikan 2013).

Many visitors and Ketchikan residents participate in outdoor recreational activities, including water-based activities such as fishing, boating, kayaking, wildlife viewing, SCUBA diving, and snorkeling. Numerous designated recreation areas are in the area, including several near the SEAFAC. The Ketchikan Coastal Management Program Plan (Ketchikan Gateway Borough 2007) identifies several open-water areas near the SEAFAC as heavy or moderate recreational boating and fishing areas. These waters include portions of Western Behm Canal around Betton and Back Islands, Clover Passage, Clover Pass, Smuggler's Cove, and Helm Bay. Clover Pass, which is immediately west of the SEAFAC, is one of the borough's main boating and sport fishing areas and is highly regarded for its scenic value. With its three marinas and three resorts, the area is also very popular with sport fishermen for nearshore and open-water fishing, as well as for diving (Ketchikan Gateway Borough 2007). Some of the popular recreational areas in the immediate vicinity of the SEAFAC include the following:

- Betton Island State Marine Park consists of 280 acres (ac.) (113 hectares [ha]) of undeveloped land with no facilities and 408 ac. (165 ha) of tidelands and marine waters on the southeastern shoreline of Betton Island. Uses include kayaking, boating, beachcombing, SCUBA diving, camping, fishing, hunting, wildlife viewing, and commercial guide activity (Ketchikan Gateway Borough 2007).
- Grant and Joe Islands State Marine Park has approximately 592 ac. (240 ha) of undeveloped uplands on the islands and surrounding tidelands. It is well known as a kayak resting area and for picnicking and camping. This park is accessible by boat and float plane only (Ketchikan Gateway Borough 2007).

Settler's Cove State Recreation Area consists of 275 ac. (111 ha), including a sandy beach, Clover Passage. It is accessible by road or boat and has developed campsites, a picnic area, and a waterfall (Ketchikan Gateway Borough 2007).

3.12.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact socioeconomic resources of the Study Area. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each

alternative (including number of events and ordnance expended). Each socioeconomic resource stressor is introduced and, within the Offshore Area, Inland Waters, and Southeast Alaska areas, analyzed by alternative for training and testing activities. Table F-3 in Appendix F shows the warfare areas and associated stressors that were considered for analysis of socioeconomic resources. The stressors vary in intensity, frequency, duration, and location within the Study Area. Table 3.12-3 shows the number of components or activities for each stressor with respect to location and changes among the alternatives. The analysis of training and testing activities presented in this section considers relevant components and data associated with the geographic location of the activity and the resource. Training activities are not proposed in the Western Behm Canal; therefore, only activities in the Offshore Area and the Inland Waters will be analyzed under training activities. The primary stressors applicable to socioeconomic resources in the Study Area and that are analyzed include the following:

- Accessibility
- Physical disturbances and interactions
- Airborne acoustics
- Secondary impacts from changes to the availability of marine resources

Secondary stressors resulting in indirect impacts on socioeconomic resources are discussed in Section 3.12.3.4 (Secondary Impacts). Analysis of economic impacts evaluates the impacts of the alternatives on the economy of the region of influence, while analysis of social impacts considers the change to human populations and how the action alters the way individuals live, work, play, relate to one another, and function as members of society. Because proposed NWTT activities are predominantly offshore and within inland waters, socioeconomic impacts would be associated with economic activity, employment, income, and social conditions (e.g., livelihoods) of industries or operations that use the ocean and inland waterways (Puget Sound and Western Behm Canal) within the Study Area. Although no permanent population centers are within the region of influence and the typical socioeconomic considerations such as population, housing, and employment are not applicable, this section will analyze the potential for fiscal impacts on marine-based activities and coastal communities. When considering impacts on recreational activities such as fishing, boating, and tourism, both the economic impact associated with revenue from recreational tourism and public enjoyment of recreational activities are considered.

The proposed NWTT activities were evaluated to identify specific components that could act as stressors by having direct or indirect effects on sources of commercial transportation and shipping, commercial and recreational fishing, and tourism. For each stressor, a discussion of impacts on these sources is included for each alternative.

Inland portions of the Study Area also include Navy pierside locations, where sonar maintenance and testing occur, at NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett. The Navy has specific locations in the Inland Waters that are used for both training and testing. The primary activities within the Inland Waters are testing. The Navy piers, known as waterfront restricted areas, are restricted for physical security and law enforcement. The overarching requirements for safety and security at the Navy piers minimize the potential for socioeconomic impacts from Navy activities. Therefore, the potential socioeconomic impacts of training and testing activities at Navy piers are not analyzed further.

3.12.3.1 Accessibility

Navy training and testing activities have the potential to temporarily limit access to areas of the ocean for a variety of human activities associated with commercial transportation and shipping, commercial and recreational fishing, subsistence use, and tourism in the Study Area.

Table 3.12-3: Stressor Table for Socioeconomic Resources

Components	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Accessibility							
Activities including vessels	Offshore Area	996	37	1,088	138	1,088	162
	Inland Waters	4	337	31	582	31	640
	W. Behm Canal	0	28	0	60	0	83
Activities including aircraft	Offshore Area	3,826	2	6,471	74	6,471	84
	Inland Waters	124	2	127	20	127	25
	W. Behm Canal	0	0	0	0	0	0
Airborne Acoustics							
Activities including aircraft	Offshore Area	3,826	2	6,471	74	6,471	84
	Inland Waters	124	2	127	20	127	25
	W. Behm Canal	0	0	0	0	0	0
Physical Disturbance and Interactions							
Activities including vessels	Offshore Area	996	37	1,096	138	1,096	162
	Inland Waters	4	337	53	582	53	640
	W. Behm Canal	0	28	0	60	0	83
Activities including in-water devices	Offshore Area	429	40	484	154	484	183
	Inland Waters	0	379	1	648	1	716
	W. Behm Canal	0	0	0	0	0	0
Military expended materials	Offshore Area	186,584	621	191,664	2,511	191,664	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Secondary Impacts							
Availability of resources	Offshore Area	Qualitative					
	Inland Waters						
	W. Behm Canal						

The purpose of halting marine traffic in some instances is to eliminate acoustic interference during noise-sensitive testing. Typically, marine traffic is allowed to pass during the interval between test activities. When training or testing activities are scheduled that require specific areas to be free of nonparticipating vessels because of possible hazards to navigation, the Navy may request that the U.S. Coast Guard issue NTMs to warn the public of upcoming Navy activities. Training and testing activities occur in established restricted or danger areas, as published on navigation charts. For most testing activities, halting marine traffic is typically not required because activities run at sufficient depth and have no live warheads that would present a risk to surface vessels. The DBRC Site has unique fixed

warning lights that warn nonmilitary craft of the status of Navy activities. The descriptions of the lights are posted at local boat ramps and marinas and are clearly indicated on standard National Oceanic and Atmospheric Administration charts (e.g., National Oceanic and Atmospheric Administration Nautical Chart No. 18458). In accordance with 32 C.F.R. Part 761, a 500 yd. (457 m) protection zone is established around all U.S. Navy vessels in navigable waters of the United States and within the boundaries of U.S. Coast Guard Pacific Area. All vessels must proceed at a no-wake speed within a protection zone. Nonmilitary vessels are not permitted to enter within 100 yd. (91 m) of a U.S. naval vessel, whether underway or moored, unless authorized by an official patrol. The changes in accessibility to human activities in the ocean or inland waterways would be an impact if it directly contributed to loss of income, revenue, or employment. Disturbance to human activities that result in impacts on payrolls, revenue, or employment is quantified by the amount of time the activity may be halted or rerouted or the ability to move to another location.

3.12.3.1.1 No Action Alternative

3.12.3.1.1.1 Training

Offshore Area

Under the No Action Alternative, potential accessibility impacts would be associated primarily with anti-air warfare, anti-surface warfare, and anti-submarine warfare. Training activities would continue at current levels and within Pacific Northwest OPAREA. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Inland Waters

Under the No Action Alternative, potential accessibility impacts would be associated primarily with mine warfare, naval special warfare, and search and rescue. Training activities would continue at current levels and within established ranges and training locations. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.1.1.2 Testing

Offshore Area

Under the No Action Alternative, active sonar testing activities such as unmanned underwater vehicles and countermeasure testing would continue at current levels in the Quinault Range Site and surf zone off Pacific Beach. Systems and subsystems testing would continue to occur in the Quinault Range Site. No testing activities involving underwater explosions, such as anti-submarine warfare, would be conducted under the No Action Alternative. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring)

and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Inland Waters

Under the No Action Alternative, potential accessibility impacts would be associated primarily with torpedo testing and anti-surface warfare/anti-submarine warfare. Torpedo testing, unmanned aircraft system testing, unmanned underwater vehicle testing, and miscellaneous testing in the DBRC Site and Keyport Range Site could cause temporary delays in access to these areas. Navy procedures for limiting access during testing events are described in Section 3.13.2.2 (Safety and Inspection Procedures). There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Western Behm Canal

Acoustic measurements would be conducted at current levels (28 events per year) at SEAFAC under the No Action Alternative. Proposed activities include surface vessel acoustic measurement, underwater vessel acoustic measurement, underwater vessel hydrodynamic performance measurement, component system testing, and measurement system repair and replacement.

The restricted areas provide for vessel and public safety, lessen acoustic encroachment from nonparticipating vessels, and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. The restrictions during testing potentially conflict with other uses of Western Behm Canal, including commercial and recreational fishing, marine transportation, pleasure boating, and touring. Potential accessibility impacts are minimized through specific provisions in 33 C.F.R. § 334, including the following:

- Each closure of the area by the Navy will normally not exceed 20 minutes. This provision minimizes the effects of the temporary restrictions to a minor inconvenience. Also, small craft may operate within 500 yd. (457 m) of the shoreline at speeds no greater than 5 knots. This greatly reduces the potential for conflicts with users such as recreational fishermen, charter fishing guides, kayakers, and other small craft users that normally transit the area close to the shoreline.
- From May 1 through September 15 annually, the Navy conducts acoustic measurement tests that result in transitory restrictions in Area 5 for a total of no more than 15 days. This falls within the cruise ship season, when visitation and recreational use of Western Behm Canal is highest and when vessel traffic associated with commercial fishing is most likely. This provision ensures that at least 89 percent of the days during this important time would be free of transit restrictions.
- Public notification that the Navy will conduct operations in Western Behm Canal is given at least 72 hours in advance to the following Ketchikan contacts: U.S. Coast Guard, Ketchikan Gateway Borough Planning Department, Harbor Master, Alaska Department of Fish and Game, KRBD radio, KTKN radio, and the *Ketchikan Daily News*. Public notification may also be obtained by monitoring very high frequency channel 16.

- Vessels are allowed to transit Restricted Area 5 within 20 minutes of marine radio or telephone notification to the Navy range operations officer.

The restricted area requirements outlined above have allowed the Navy to conduct acoustic testing in Western Behm Canal for about 20 years while minimizing conflicts with and impacts on other users. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.1.2 Alternative 1

3.12.3.1.2.1 Training

Offshore Area

Under Alternative 1, air combat maneuvers, missile exercises, helicopter tracking exercises, electronic warfare exercises, submarine mine exercises, and ship sonar maintenance would increase but would continue within established locations. The number of activities involving aircraft or vessels that may impact accessibility increases from 4,822 under the No Action Alternative to 7,559 under Alternative 1 (see Table 3.12-3). Half of the increase would be for air combat maneuvers and electronic warfare operations. The remainder of the training activities would remain the same as the No Action Alternative. As with the No Action Alternative, potential accessibility impacts would be associated primarily with anti-air warfare, anti-surface warfare, and anti-submarine warfare. No sinking exercises would be performed under Alternative 1. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Inland Waters

The proposed adjustments to baseline training activities include anti-surface warfare activities, mine warfare activities, and civilian port defense. Alternative 1 includes the addition of small-boat attack events. Training events in Inland Waters would increase compared to the No Action Alternative. The number of activities involving aircraft or vessels that may impact accessibility increases from 128 under the No Action Alternative to 158 under Alternative 1. The naval special warfare activities would not change from the No Action Alternative. While Alternative 1 would adjust the location and frequency of training activities, the Navy would continue to implement strict standard operating procedures. Despite the increase in frequency of training activities, there would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.1.2.2 Testing

Offshore Area

Under Alternative 1, the number of testing activities would increase; half of the events would be anti-submarine warfare testing conducted by Naval Air Systems Command (NAVAIR) in the Pacific Northwest OPAREA. The number of activities involving aircraft or vessels that may impact accessibility increases from 39 under the No Action Alternative to 212 under Alternative 1 (see Table 3.12-3). Despite the increase in testing, there would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Inland Waters

Testing events in the Washington state Inland Waters would increase under Alternative 1 over the No Action Alternative. The number of activities involving aircraft or vessels that may impact accessibility increases from 339 under the No Action Alternative to 602 under Alternative 1. The increase would allow for future testing requirements. Despite the increase, there would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Western Behm Canal

Under Alternative 1, acoustic measurements would increase. The number of activities involving vessels that may impact accessibility increases from 28 under the No Action Alternative to 60 under Alternative 1. Despite the increase, there would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.1.3 Alternative 2

3.12.3.1.3.1 Training

Offshore Area

The proposed numbers of events for training activities for Alternative 2 would increase compared to the No Action Alternative and are identical to the numbers proposed under Alternative 1 (Table 3.12-3). Therefore, the impacts from Alternative 2 compared to the No Action Alternative would be the same as described under Alternative 1. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the

large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Inland Waters

The only proposed adjustment to training activities that could impact accessibility of the public to training areas in Inland Waters is an increase from three exercises per 5-year period to annually for civilian port defense. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.1.3.2 Testing

Offshore Area

The number of testing events would increase under Alternative 2 compared to the No Action Alternative and Alternative 1. The number of activities involving aircraft or vessels that may impact accessibility increases from 39 under the No Action Alternative to 246 under Alternative 2 (see Table 3.12-3). Despite the increase in testing, there would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Inland Waters

Testing activities would increase under Alternative 2. The increase would allow for future testing requirements. The number of activities involving aircraft or vessels that may impact accessibility increases from 339 under the No Action Alternative to 665 under Alternative 2. Despite the increase, there would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

Western Behm Canal

Under Alternative 2, the number of testing events would increase compared with the No Action Alternative and Alternative 1 to allow for future testing requirements. The number of activities involving aircraft or vessels that may impact accessibility increases from 28 under the No Action Alternative to 83 under Alternative 2. The restricted area requirements and measures that minimize conflicts would continue to be implemented. There would be no anticipated impacts on commercial transportation and shipping, commercial and recreational fishing, subsistence use, or tourism because inaccessibility to areas of co-use would be infrequent and of short duration (hours). Based on the Navy's standard

operating procedures (Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and the large expanse area, accessibility impacts would remain negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.2 Physical Disturbance and Interactions

The evaluation of impacts on socioeconomic resources from physical disturbance and interaction stressors focuses on direct physical encounters or collisions with objects moving through the water or air (e.g., vessels, aircraft, unmanned devices, and towed devices), dropped or fired into the water (e.g., non-explosive practice munitions, other military expended materials, and ocean bottom deployed devices), or resting on the ocean floor (e.g., anchors, mines, and targets) that may damage or encounter civilian equipment. Because of the nature of vessel movements during SEAFAC testing, the lack of military expended materials, and the remote likelihood of physical disturbance or interaction, it will not be analyzed.

Physical disturbances that damage equipment and infrastructure could disrupt the collection and transport of products, which may impact industry revenue or operating costs. Interactions may involve training or testing activities that do not physically interact with socioeconomic resources but may interact in a way that affects the resources. Included in this category of stressors is the use of sonar. For sonar to affect socioeconomic resources, the underwater acoustic sound would have to alter commercial transportation, commercial or recreational fishing, or tourism in a way that causes an economic impact. Most recreational fishing in the Study Area takes place in state waters, where the Navy conducts very limited training. Less than 10 percent of recreational fishing takes place in federal waters, which are beyond 3 nm from shore. Recreational fishing typically occurs within 3 nm of shore. Therefore, most recreational fishing in the Offshore Area would occur away from physical disturbances and interactions associated with training and testing activities. Most commercial fishing occurs beyond 3 nm in Navy training and testing areas and could be affected by proposed activities if those activities were to alter fish population levels in those areas to such an extent that commercial fishers could no longer find their target species. As described in Section 3.9.3 (Fish – Environmental Consequences), the behavioral responses that could occur from various types of physical stressors associated with training and testing activities would not compromise the general health or condition of fish and, therefore, commercial or recreational fishing resources.

Commercial fishing activities have the potential to interact with equipment placed in the ocean or on the ocean floor for use during proposed Navy training and testing activities. This equipment could include ship anchors, moored or bottom-mounted targets, mines and mine shapes, tripods, and towed-system and attachment cables. Many different types of commercial fishing gear are used in the Study Area, including gillnets, longline gear, troll gear, trawls, seines, and traps or pots. Commercial bottom-fishing activities that use these types of gear have a greater potential to be affected by interaction with Navy training and testing equipment, resulting in the loss of or damage to both the Navy equipment and the commercial fishing gear. The Navy recovers many of the targets (e.g., mines and mine shapes) and target fragments used in training and testing activities, and it would continue to do so to minimize the potential for interaction with fishing gear and fishing vessels.

Unrecoverable items are typically small, constructed of soft materials (such as target cardboard boxes or tethered target balloons), or intentionally designed to sink to the bottom after serving their purpose (such as expended 55-gallon steel drums), so they would not represent a collision risk to vessels, including commercial fishing vessels. Commercial fishing activities that drag gear along the bottom could

snag unrecoverable items such as expended 55-gallon steel drums and damage their gear. As discussed in Section 3.1 (Sediments and Water Quality), a west coast study categorized types of marine debris collected by a trawler during a groundfish survey. Military expended materials categorized as plastic, metal, fabric and fiber, and rubber accounted for 7.4, 6.2, 13.2, and 4.7 percent, respectively, of the total count of items collected. The footprint of military expended materials in the Study Area is discussed in Section 3.3 (Marine Habitats), which concludes that if all military expended materials were placed side by side in the Study Area, the footprint would be approximately 0.04 nm^2. Because this footprint is so small relative to the size of the Study Area, recreational and commercial fishers probably would not encounter military expended materials. Damage to fishing gear from Navy mine and submarine warfare activities in the Offshore Area is rare. When damage does occur to commercial fishing gear due to Navy actions (e.g., net entanglement, destructions of buoys), the fishermen (or the owner of the property damaged) can file a claim with the Department of the Navy under the Federal Tort Claims Act under the provisions of 28 U.S. Code Section 2671, et seq. and request reimbursement. Forms for filing a claim under the act can be obtained from any Naval Legal Service Office. Reimbursement requests must be made within 2 years of incurring damage.

Military expended materials can physically interact with civilian equipment and infrastructure. Almost all training and testing activities produce military expended materials such as chaff, flares, projectiles, casings, target fragments, missile fragments, rocket fragments, and ballast weights. There would be a remote chance that fishermen using nets could recover military expended materials. No military expended materials would be associated with activities at the SEAFAC.

While Navy training and testing activities can occur throughout the Study Area, most (especially hazardous) activities occur well out to sea. Most civilian recreational activities engaged in by tourists and residents take place within a few miles of land. Snorkeling and diving take place primarily at known recreational sites, including shipwrecks and reefs. Temporary range clearance procedures in these areas do not adversely affect tourism activities because displacement is of short duration (typically less than 24 hours) and is in areas where tourism activities are not as prevalent. The Navy temporarily limits public access to areas where there is a risk of injury or property damage by using NTMs. Published notices allow recreational users to adjust their routes to avoid temporary restricted areas. If civilian vessels are within a testing or training area at the time of a scheduled operation, Navy personnel continue operations and avoid them if it is safe and possible to do so. If avoidance is not safe or possible, the operation may relocate or be delayed. In some instances when safety requires exclusive use of a specific area, nonparticipants in the area are asked to relocate to a safer area for the duration of the operation. Because Navy training and testing activities vary in location and are primarily short term in duration, impacts on tourism activities from rerouting or postponing activities would be negligible.

Other commercial tourism activities such as whale watching tours occur around the San Juan Islands and within Puget Sound by boat or aircraft. These activities would be conducted with boats that are typically well marked and visible to Navy ships conducting training and testing activities. Individual boaters engaged in tourism activities, such as whale watching, plan and monitor navigational information to avoid Navy training and testing areas. Vessels are responsible for being aware of designated danger areas in surface waters and any NTMs that are in effect. Operators of recreational or commercial vessels have a duty to abide by maritime requirements as administered by the U.S. Coast Guard. At the same time, Navy vessels ensure that an area is clear of nonparticipants before training and testing exercises. As a result, conflicts between Navy training and testing activities in the Offshore Area and whale watching or other offshore recreational use would not occur. Changes to current offshore tourism

activities in the Study Area would not be expected from proposed training and testing activities. Therefore, loss of revenue or employment associated with tourism would not occur.

Navy training and testing equipment and vessels moving through the water could collide with non-Navy vessels and equipment. Training and testing activities that involve equipment and vessel movement operate under Navy standard operating procedures as described in Section 3.13.2.2 (Safety and Inspection Procedures). The likelihood that Navy equipment or vessels would collide with a non-Navy vessel is remote because of the prevalent use of navigational aids or buoys separating vessel traffic, shipboard Lookouts, radar, and marine band radio communications by both Navy and civilians. Therefore, the potential to impact commercial transportation and shipping by physical disturbance or interaction is negligible and requires no further analysis.

Aircraft conducting training or testing activities in the Study Area operate in designated military special use airspace (e.g., warning areas, restricted areas). All aircraft (military and civilian) are subject to Federal Aviation Administration regulations, which define permissible uses of designated airspace and are implemented to control those uses. These regulations are intended to accommodate the various categories of aviation, whether military, commercial, or general aviation. By adhering to these regulations, the likelihood of civilian aircraft encountering military aircraft or ordnance is remote. In addition, Navy aircraft follow procedures outlined in Navy and Federal Aviation Administration Instructions, which are specific to a warning area or other special use airspace and which describe procedures for operating safely when civilian aircraft are in the vicinity.

3.12.3.2.1 No Action Alternative

3.12.3.2.1.1 Training

Offshore Area

Weapons firing exercises and ordnance use in the Pacific Northwest OPAREA would generally be conducted beyond 12 nm of shore (outside U.S. territorial waters) under the No Action Alternative. Under this alternative, active sonar training activities such as anti-submarine warfare and mine warfare would continue at current levels and within the established NWTRC. Most of the active sonar activities are conducted in the Pacific Northwest OPAREA. The Navy's implementation of strict operating procedures protects public health and safety from any training activities that would occur within U.S. territorial waters. These operating procedures include ensuring clearance of the area before commencing training activities involving physical interactions. Because of the Navy's strict operating procedures, the potential for impacts on the public from physical disturbances or interactions because of Navy training activities under the No Action Alternative is negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Mine warfare activities, as well as naval special warfare activities, could impact socioeconomic resources by direct physical disturbances or interactions. However, the Navy's implementation of strict operating procedures would protect the public from direct physical disturbances or interactions with Navy training activities. Prior public notification of hazardous Navy activities, use of known training areas, avoidance of nonmilitary vessels and personnel, maintenance of minimum separation distances between nonmilitary vessels and Navy vessels, use of standard operating procedures for clearance of ranges, and use of restricted access areas reduce the potential for interaction between the public and Navy activities. With the implementation of the Navy's strict operating procedures, the potential for training

activities to increase the public's physical disturbances or interactions with Navy training activities under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.2.1.2 Testing

Offshore Area

Under the No Action Alternative, active sonar testing activities such as unmanned underwater vehicles and countermeasure testing would continue at current levels (see Table 3.12-3). The Navy's implementation of strict operating procedures protects public interactions with any Navy testing activities that would occur within U.S. territorial waters. These operating procedures include ensuring clearance of the area before commencing with testing activities. Because of the Navy's strict operating procedures, the potential for impacts from physical disturbances or interactions for the public because of Navy testing activities under the No Action Alternative is negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Testing activities could impact socioeconomic resources by direct physical disturbances or interactions. Countermeasure materials expended during testing are sought for recovery and test evaluation. Torpedoes used for testing do not contain explosives and are recovered for reuse and for performance evaluation. However, materials such as decelerator/parachutes, guidance wires, and ballast weights are expended. Targets may be temporarily deployed and then recovered. Stationary targets may be either floating suspended or anchored in the water column. If there is a navigational hazard, then an NTM is issued for advisory notice to the public. Because of the Navy's strict operating procedures, the potential for testing activities to increase the public's physical disturbances or interactions with Navy testing activities under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

Acoustic measurements would be conducted at current levels (28 events per year) at SEAFAC. Proposed activities include surface vessel acoustic measurement, underwater vessel acoustic measurement, underwater vessel hydrodynamic performance measurement, component system testing, and measurement system repair and replacement. The Navy's implementation of strict operating procedures protects public health and safety from any training activities that would occur within U.S. territorial waters. These operating procedures include ensuring clearance of the area before commencing training activities involving physical interactions. Because of the Navy's strict operating procedures, the potential for impacts on the public from physical disturbances or interactions because of Navy training activities under the No Action Alternative is negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.2.2 Alternative 1

3.12.3.2.2.1 Training

Offshore Area

Under Alternative 1, the number of training events would increase but would continue within established locations. The number of activities involving vessels, in-water devices, or military expended materials that have potential for physical disturbance or interaction would increase from 188,009 under the No Action Alternative to 193,244 under Alternative 1 (see Table 3.12-3). However, the increased number of aircraft and vessel movements and the use of targets and expended materials would be conducted under the same safety and inspection procedures as under the No Action Alternative. Under Alternative 1, training activities in the Pacific Northwest OPAREA that could increase risk of physical disturbances or interactions with the public would likely be conducted outside U.S. territorial waters. Active sonar training would continue at current locations as described under the No Action Alternative. While Alternative 1 would adjust the frequency of training activities, the Navy would continue to implement strict standard operating procedures. Therefore, the potential for impacts of physical interactions with Navy training activities beyond those identified under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

The proposed adjustments to baseline training activities would increase Inland Waters training and include anti-surface warfare activities, mine warfare activities, and civilian port defense. Alternative 1 also includes the addition of small boat attack events, which will occur in areas where restrictions are in place to avoid encounters with nonparticipants. Activities involving vessels, in-water devices, and military expended materials with the potential for physical disturbance and interaction would increase from 12 under the No Action Alternative to 139 under Alternative 1. While Alternative 1 would adjust the frequency of training activities, the Navy would continue to implement strict standard operating procedures (U.S. Department of the Navy 2009b). Therefore, the potential for training activities under Alternative 1 to increase the public's physical disturbances or interactions with Navy training beyond those identified under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.2.2.2 Testing

Offshore Area

The frequency of testing activities would increase under Alternative 1; half of the increase would be for anti-submarine warfare activities in the Pacific Northwest OPAREA. The frequency of active sonar testing activities would increase over the No Action Alternative, allowing for future testing requirements by Naval Sea Systems Command and NAVAIR. The number of activities involving vessels, in-water devices, or military expended materials that have potential for physical disturbance or interaction would increase from 698 under the No Action Alternative to 2,803 under Alternative 1 (see Table 3.12-3). Because of the Navy's strict operating procedures, the potential for testing activities to increase the public's risk of physical disturbances or interactions with Navy testing activities under Alternative 1 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Testing activities would increase under Alternative 1 and would occur in new locations such as Carr Inlet and within the restricted pierside area. Sonar use for testing activities and miscellaneous testing activities would be similar to that described under the No Action Alternative. The increase would allow for future testing requirements. Activities involving vessels, in-water devices, and military expended materials with the potential for physical disturbance and interaction would increase from 1,162 under the No Action Alternative to 1,747 under Alternative 1. Despite the increase in the number of testing events, the potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to the No Action Alternative due to the continued implementation of strict operating procedures that ensure that these areas are clear of nonparticipants (U.S. Department of the Navy 2009b). Therefore, the potential for testing activities under Alternative 1 to increase the public's risk of physical disturbances or interactions with Navy testing activities beyond those identified under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

Under Alternative 1, acoustic measurements would be conducted at SEAFAC in the five restricted areas within Western Behm Canal. Activities involving vessels with the potential for physical disturbance and interaction would increase from 28 under the No Action Alternative to 60 under Alternative 1. The restricted areas provide for vessel and public safety, lessen acoustic encroachment from nonparticipating vessels, and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. Because of the Navy's strict operating procedures, the potential for physical disturbance or interactions with commercial or recreational vessels would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.12.3.2.3 Alternative 2

3.12.3.2.3.1 Training

Offshore Area

The proposed numbers of events for training activities for Alternative 2 would increase compared to the No Action Alternative and are identical to the numbers proposed under Alternative 1 (see Table 3.12-3). Therefore, the impacts from Alternative 2 compared to the No Action Alternative would be the same as described under Alternative 1. The potential for a direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar under Alternative 2 to those under Alternative 1. The Navy would continue to implement strict standard operating procedures. Therefore, the potential for impacts under Alternative 2 due to physical disturbances or interactions with the public beyond those identified under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

The only proposed adjustment to training activities that could increase the risk of physical disturbances or interactions is an increase from three exercises per 5-year period to annually for civilian port defense. The Navy would continue to implement strict standard operating procedures. The potential for training activities under Alternative 2 to increase the public's physical interactions with Navy training beyond those identified under the No Action Alternative would be negligible. Therefore, implementation of

Alternative 2 would have negligible impacts on socioeconomic resources. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.2.3.2 Testing

Offshore Area

The frequency of testing activities would increase under Alternative 2. The number of activities involving vessels, in-water devices, or military expended materials that have potential for physical disturbance or interaction would increase from 698 under the No Action Alternative to 3,109 under Alternative 2 (see Table 3.12-3). The increase would allow for future testing requirements. Because of the Navy's strict operating procedures, the potential for impacts under Alternative 2 due to physical disturbances or interactions with the public beyond those identified under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Testing activities would increase under Alternative 2 and would occur in the same locations in the Inland Waters to allow for future testing requirements. Activities involving vessels, in-water devices, and military expended materials with the potential for physical disturbance and interaction would increase from 1,162 under the No Action Alternative to 1,924 under Alternative 2. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to the No Action Alternative due to the continued implementation of strict operating procedures that ensure that these areas are clear of nonparticipants (U.S. Department of the Navy 2009b). Therefore, the potential for testing activities under Alternative 2 to increase the public's physical interactions with Navy testing beyond those identified under the No Action Alternative would be negligible and would have negligible impacts on socioeconomic resources. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

The proposed adjustment to Alternative 2 testing activities includes an increased frequency of operations to allow for future testing requirements. Activities involving vessels with the potential for physical disturbance and interaction would increase from 28 under the No Action Alternative to 83 under Alternative 2. While Alternative 2 would increase the number of events, the Navy would continue to implement strict standard operating procedures. The potential for physical disturbance or interactions with commercial or recreational vessels would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.12.3.3 Airborne Acoustics

As a stressor, loud noises, sonic booms, and vibrations generated from Navy training and testing activities such as aircraft transiting have the potential to disrupt wildlife and humans in the Study Area. Airborne noise is not anticipated to impact commercial transportation and shipping, commercial fishing, and subsistence fishing within the Study Area; therefore, no further analysis is needed.

Noise interference could decrease public enjoyment of recreational activities. The public would hear noise from aircraft overflights and other training and testing activities if they are in the vicinity of an

event, but there would be no impact on public enjoyment of recreational activities leading to a loss of revenue because of the infrequency and duration of events. These effects would occur on a temporary basis and only when Navy activities are occurring. Most Navy training and testing activities require the area to be clear of nonparticipants, reducing the potential that noise from these activities would disturb tourists. Further, most naval training would occur well out to sea, while tourism and civilian recreational activities are largely conducted within a few miles of shore.

3.12.3.3.1 No Action Alternative

3.12.3.3.1.1 Training

Offshore Area

Under the No Action Alternative, potential airborne noise impacts would be associated primarily with anti-air warfare, anti-surface warfare, anti-submarine warfare, and mine warfare. Training activities would continue at current levels and within established ranges and training locations. There would be no anticipated impacts on tourism because most Navy training occurs well out to sea, while most tourism and recreational activities occur near shore, and Navy training activities producing airborne noise are normally short term and infrequent. Therefore, airborne noise impacts on tourism under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Mine warfare activities, as well as naval special warfare activities, could cause temporary increases in airborne noise from helicopters. The airborne noise would be for short duration, localized, and away from areas where tourists are located.

In accordance with the *Pacific Northwest Training Range Complex Manual* (U.S. Department of the Navy 2010b), supersonic flights are not conducted in the Olympic MOA. In accordance with Navy Instruction 3710.7T, *NATOPS General Flight and Operating Instructions*, noise sensitive areas, including national parks and national recreational areas, shall be avoided when at altitudes of less than 3,000 ft. (914.4 m) above ground level (U.S. Department of the Navy 2009a).

Air combat maneuvers, electronic warfare operations, and search and rescue activities would continue at current levels in the Olympic MOA. Approximately 120 events were conducted in the Olympic MOA between August 2011 and August 2012, which represents approximately 3 percent of the proposed activities for air combat maneuvers, electronic warfare operations, and search and rescue activities. Tourism access to the Olympic National Park and Olympic National Forest underneath the Olympic A and B MOA was not restricted because of airspace activities. Because airborne noise generated from the activities is intermittent, mostly high-altitude overflights; occurs in remote areas; and does not involve high noise levels (i.e., flights are greater than 3,000 ft. above ground level and no supersonic flights occur), it is unlikely that sensitive human receptors would be adversely exposed to airborne noise from military activities.

The potential for training activities under the No Action Alternative to impact tourism is negligible. Therefore, the potential impacts of airborne noise under the No Action Alternative are negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.3.1.2 Testing

Offshore Area

The majority of offshore testing under the No Action Alternative would be within the Quinault Range Site. Testing activities would not produce high levels of airborne noise due to the nature of the tests, which primarily occur underwater. Helicopters or surface vessels would be used in many of the tests. Airborne noise from these tests is not expected to impact tourism because the testing would not be near areas of tourism, the noise is not substantially loud, and the tests are infrequent. Further, noise from these activities is similar to sounds generated from non-Navy helicopters and vessels generally found in the area. Therefore, airborne noise impacts on tourism under the No Action Alternative would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Torpedo testing and miscellaneous testing would be conducted at current levels. The airborne noise produced from surface vessels would be for short durations, localized, and away from tourist areas. The potential for testing activities under the No Action Alternative to impact tourism is negligible. Therefore, the potential impacts of airborne noise under the No Action Alternative are negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

There are no activities including aircraft that produce airborne noise in the Western Behm Canal.

3.12.3.3.2 Alternative 1

3.12.3.3.2.1 Training

Offshore Area

Compared to the No Action Alternative, offshore training activities proposed under Alternative 1 that may cause an increase in airborne noise would include air combat maneuvers and electronic warfare operations. These activities would increase from 3,826 under the No Action Alternative to 6,471 under Alternative 1 (see Table 3.12-3). Generally, these training flights are at high altitudes and offshore. Airborne noise is attenuated substantially before reaching the surface. Therefore, airborne noise impacts on tourism under Alternative 1 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Alternative 1 would increase the number of mine warfare training activities in the underwater training ranges, Crescent Harbor, or Hood Canal. Activities that include aircraft generating airborne noise with the potential to impact tourism would increase from 124 under the No Action Alternative to 127 under Alternative 1. Rotary-wing aircraft may be used during these training activities, which would increase airborne noise in these ranges. The airborne noise would be for short duration, localized, and away from areas where tourists occur. For these reasons, the potential for training activities to impact tourism under Alternative 1 would be negligible.

The increased frequency of operations could result in greater airborne noise exposure of tourists visiting the Olympic National Park and Olympic National Forest. However, overflights would be conducted at greater than 3,000 ft. above ground level, and no supersonic flights would occur within the Olympic

MOA. It is unlikely that sensitive receptors would be adversely exposed to airborne noise from military activities; therefore, airborne noise under Alternative 1 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.3.2.2 Testing

Offshore Area

Activities that include aircraft generating airborne noise with the potential to impact tourism increase from two under the No Action Alternative to 74 under Alternative 1. Most of the increased number of events would be conducted more than 3 nm offshore and at high altitudes. These testing activities would not cause substantial increases in airborne noise. Therefore, airborne noise impacts on tourism under Alternative 1 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Activities that include aircraft generating airborne noise with the potential to impact tourism increase from two under the No Action Alternative to 20 under Alternative 1. Most of the increased number of events would be conducted more than 3 nm offshore and at high altitudes. These testing activities would not cause substantial increases in airborne noise. Therefore, airborne noise impacts on tourism under Alternative 1 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

There are no activities including aircraft that produce airborne noise in the Western Behm Canal.

3.12.3.3.3 Alternative 2

3.12.3.3.3.1 Training

Offshore Area

The proposed numbers of events for Alternative 2 would increase compared to the No Action Alternative and are the same as the numbers proposed under Alternative 1 (see Table 3.12-3). Impacts from Alternative 2 compared to the No Action Alternative would be the same as described under Alternative 1. Therefore, airborne noise impacts on tourism under Alternative 2 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

The proposed numbers of events for Alternative 2 would increase compared to the No Action Alternative and are the same as the numbers proposed under Alternative 1. Impacts from Alternative 2 compared to the No Action Alternative would be the same as described under Alternative 1. The airborne noise resulting from surface vessels would be for short durations, localized, and away from tourist areas. For these reasons, the potential for training activities to impact tourism under Alternative 2 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.12.3.3.3.2 Testing

Offshore Area

The proposed numbers of events for Alternative 2 would increase compared to the No Action Alternative and would increase from the numbers proposed under Alternative 1 (see Table 3.12-3). Impacts from Alternative 2 compared to the No Action Alternative would be the same as described under Alternative 1. Airborne noise from these testing activities would not cause substantial increases in airborne noise. Therefore, airborne noise impacts on tourism under Alternative 2 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

The proposed numbers of events for Alternative 2 would increase compared to the No Action Alternative and would increase from the numbers proposed under Alternative 1. Impacts from Alternative 2 compared to the No Action Alternative would be the same as described under Alternative 1. The airborne noise resulting from surface vessels would be for short durations, localized, and away from tourist areas. For these reasons, the potential for testing activities to impact tourism under Alternative 2 would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

There are no activities including aircraft that produce airborne noise in the Western Behm Canal.

3.12.3.4 Secondary Impacts

Socioeconomic resources could be impacted if proposed activities led to changes to physical and biological resources and if these activities acted as secondary stressors to the extent that they would alter the way industries can use those resources. The secondary impacts on marine resource availability pertain to the potential for loss of fisheries resources within the Study Area.

Commercial transportation and shipping would not be affected by changes to physical or biological resources. Fishing, subsistence use, and tourism could be impacted if proposed activities altered fish and other marine species population levels to such an extent that these activities could no longer find their target species. Similarly, disturbances to marine mammal populations could impact the whale watching industry. Analyses in Sections 3.4 (Marine Mammals), 3.8 (Marine Invertebrates), and 3.9 (Fish) concluded that impacts on marine species from training and testing activities are not anticipated. Based on these conclusions, secondary impacts on commercial transportation or shipping, commercial or recreational fishing, subsistence use, or tourism are not anticipated. Because impacts are not anticipated, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of these activities.

3.12.3.5 Summary of Potential Impacts of All Stressors on Socioeconomic Resources

Stressors described in this EIS/OEIS that could result in potential impacts on socioeconomic resources include accessibility to areas within the Study Area, physical disturbances and interactions, airborne acoustics, and secondary impacts resulting from effects on marine species populations. Under the No Action Alternative, Alternative 1, and Alternative 2, these activities would be widely dispersed throughout the Study Area. These activities are also dispersed temporally (i.e., few stressors would occur in the same location at the same time). Therefore, no greater impacts from the combined operation of more than one stressor are expected. The aggregate impact on socioeconomic resources would not observably differ from existing conditions.

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3.13 Public Health and Safety

TABLE OF CONTENTS

3.13 PUBLIC HEALTH AND SAFETY 3.13-1
3.13.1 INTRODUCTION AND METHODS 3.13-1
3.13.1.1 Introduction 3.13-1
3.13.1.2 Methods 3.13-2
3.13.2 AFFECTED ENVIRONMENT 3.13-3
3.13.2.1 Overview 3.13-3
3.13.2.2 Safety and Inspection Procedures 3.13-6
3.13.2.3 Aviation Safety 3.13-9
3.13.2.4 Submarine Navigation Safety 3.13-9
3.13.2.5 Surface Vessel Navigational Safety 3.13-10
3.13.2.6 Sound Navigation and Ranging Safety 3.13-10
3.13.2.7 Explosive Ordnance Detonation Safety 3.13-11
3.13.2.8 Weapons Firing and Ordnance Expenditure Safety 3.13-11
3.13.3 ENVIRONMENTAL CONSEQUENCES 3.13-12
3.13.3.1 Underwater Energy 3.13-13
3.13.3.2 In-Air Energy 3.13-19
3.13.3.3 Physical Interactions 3.13-20
3.13.3.4 Secondary Impacts 3.13-26
3.13.3.5 Summary of Potential Impacts of All Stressors on Public Health and Safety 3.13-26

LIST OF TABLES

TABLE 3.13-1: STRESSOR TABLE FOR PUBLIC HEALTH AND SAFETY 3.13-13

LIST OF FIGURES

FIGURE 3.13-1: SIMULTANEOUS ACTIVITIES WITHIN THE NORTHWEST TRAINING AND TESTING STUDY AREA 3.13-4

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3.13 PUBLIC HEALTH AND SAFETY

PUBLIC HEALTH AND SAFETY SYNOPSIS

The United States Department of the Navy (Navy) considered all potential stressors, and the following have been analyzed for public health and safety:

- Underwater Energy
- In-Air Energy
- Physical Interactions
- Secondary Impacts (from sediment and water quality changes)

Preferred Alternative (Alternative 1)

- Because of the Navy's standard operating procedures, impacts on public health and safety would be unlikely. Further, there are no disproportionately high impacts or adverse effects on any low-income or minority populations.

3.13.1 INTRODUCTION AND METHODS

3.13.1.1 Introduction

This section of the Environmental Impact Statement (EIS)/Overseas EIS (OEIS) analyzes potential impacts on public health and safety within the Northwest Training and Testing (NWTT) Study Area (hereafter referred to as the Study Area). The Study Area is described in Section 2.1 (Description of the Northwest Training and Testing Study Area) and depicted in Figure 2.1-1.

This section also addresses the potential to impact the health and safety of children. Executive Order (EO) 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children and to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. People, including children, may be present in residential areas or on board private or commercial vessels near some training or testing areas; however, the United States (U.S.) Department of the Navy's (Navy's) safety measures that protect adults from potential impacts also protect children. Therefore, the Proposed Action would not disproportionately expose children to environmental health or safety risks.

Unlike military training and testing activities conducted within the boundaries of a fenced land installation, public access to ocean areas, explosives training areas, or the overlying airspace cannot be physically controlled. An exception to this situation is the pierside maintenance and testing at Naval Base (NAVBASE) Kitsap Bangor, NAVBASE Kitsap Bremerton, and Naval Station Everett that is conducted within the waterfront restricted area. The Navy coordinates use of these restricted areas by activity and issues warnings and notices, such as Notices to Mariners (NTMs), to the public before conducting potentially hazardous activities (Section 3.13.2.2). Sensitivity to public health and safety concerns within the Study Area is heightened in areas where the public may be close to certain activities (e.g., Puget Sound). Most testing occurs in Washington State waters (within 3 nautical miles [nm] of shore) and areas where there could be interaction with the public. Most training occurs outside of state waters, where there is less potential for interaction with the public.

Generally, the greatest potential for a proposed activity to affect the public is near the coasts and shorelines because that is where public activities are concentrated. These coastal and shoreline areas could include dive sites; Native American recreational, ceremonial or extractive areas; or other recreational areas where the collective health and safety of groups or individuals that could be exposed to the hazards of training and testing would be of concern. Most commercial and recreational marine activities are close to shore and are usually limited by the capabilities of the boat used. Commercial and recreational fishing may extend as far as 100 nm from shore but is concentrated near the coast.

The alternatives were also reviewed for any disproportionately high or adverse effects on any low-income or minority populations in accordance with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. This EO requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions. The Council on Environmental Quality has emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under the National Environmental Policy Act and of developing protective measures that avoid disproportionate environmental effects on minority or and low-income populations.

3.13.1.2 Methods

Baseline public health and safety conditions were derived from the current training and testing activities in the Study Area. Existing procedures for ensuring public health and safety and other elements of the baseline (e.g., restricted areas) were derived from federal regulations, Department of Defense (DoD) directives, and Navy instructions for training and testing. These directives and instructions include criteria for public health and safety considerations for planning and execution of training and testing.

The Navy's safety measures implemented as part of standard operating procedures were considered relevant to the analysis of potential impacts on public health and safety from the underwater energy and physical interactions stressors. The analyses in Section 3.1 (Sediments and Water Quality) were used to determine the potential for secondary impacts from sediment and water quality changes to impact public health and safety.

The alternatives were evaluated based on two factors: (1) the probability for a training or testing activity to impact public health and safety, and (2) the degree to which those activities could have an impact. The likelihood that the public would be near a training or testing activity determines the potential for exposure to the activity. If the potential for exposure exists, the degree of the potential impacts on public health and safety, including increased risk of injury or loss of life, is determined. If the potential for exposure were zero, then public health and safety would not be affected. Isolated incidents and other conditions that affect single individuals, although important for safety awareness, may not rise to the level of a public health and safety issue and are not considered in this assessment (e.g., airborne noise effects are not addressed in this section).

3.13.2 AFFECTED ENVIRONMENT

3.13.2.1 Overview

All of the training and testing activities proposed in this EIS/OEIS would occur in one or more of these three range subdivisions:

- Offshore Area (Pacific Northwest Operating Area [OPAREA], including the surf zone at Pacific Beach)
- Inland Waters (Washington State inland waters)
- Western Behm Canal, Alaska (Southeast Alaska Acoustic Measurement Facility [SEAFAC])

The areas of interest for assessing potential impacts on public health and safety are the Washington State inland waters and the U.S. territorial waters (seaward of the mean high water line to 12 nm) in the Study Area. Section 2.1 (Description of the Northwest Training and Testing Study Area) describes the Study Area in detail. Descriptions of the affected environment are presented for three distinct areas of the Study Area because, for the most part, the three areas have distinct activities and resources. Safety and inspection procedures are described for specific areas where appropriate; otherwise, the affected environment descriptions apply to all areas.

The Offshore Area includes air, surface, and subsurface OPAREAs extending generally west from the coastline of Washington, Oregon, and northern California for about 250 nm into international waters. In Washington, the eastern boundary of the Offshore Area abuts the coastline for 1 mile of surf zone at Pacific Beach; while in Oregon and Northern California, the boundary lies 12 nm off the coastline. It also includes the Quinault Range Site. The Offshore Area is further described in Section 2.1.1 (Description of the Offshore Area).

The Inland Waters includes air, sea, and undersea space inland of the coastline and eastward to include the Strait of Juan de Fuca, the Puget Sound, and the Strait of Georgia. None of this area extends into Oregon or California. The Inland Waters are further described in Section 2.1.2 (Description of the Inland Waters).

SEAFAC has three major functional components: (1) Back Island Operations Center and supporting facilities, (2) Underway Measurement Site, and (3) Static Site (see Figure 2.1-4). The three major functional components are within the five restricted areas in Western Behm Canal. The main purposes of the restricted areas are to lessen acoustic encroachment from nonparticipating vessels and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. The perimeter of Restricted Area 5 constitutes the Study Area boundary, and the Study Area will not include land-based support facilities or operations. The sensors at SEAFAC are passive and measure radiated noise in the water, such as from machinery on submarines or other underwater vessels. SEAFAC does not use tactical mid-frequency active sonar (sound navigation and ranging). Active acoustic sources are used for communications and range calibration and to provide position information for units operating submerged on the range. Further description of the Western Behm Canal is in Section 2.1.3 (Description of the Western Behm Canal, Alaska).

Military, commercial, institutional (including Native American activities), and recreational activities take place simultaneously in the Study Area (Figure 3.13-1) and have coexisted safely for decades because established rules and practices lead to safe use of the waterway and airspace. The following paragraphs briefly discuss the rules and practices for recreational, commercial, institutional, and military use in sea surface areas and airspace. The safety and inspection procedures are implemented for training and

testing activities. Each commanding officer is responsible for implementing safety and inspection procedures for activities inside and outside established ranges. In the absence of specific guidance on matters of safety, the Navy follows the most prudent course of action.

Figure 3.13-1: Simultaneous Activities within the Northwest Training and Testing Study Area

3.13.2.1.1 Sea Space

Most of the sea space in the Study Area is accessible to recreational and commercial activities. However, some activities are prohibited or restricted in certain areas (e.g., danger zones and restricted areas) in accordance with Title 33 Code of Federal Regulations (C.F.R.) Part 334, *Danger Zone and Restricted Area Regulations*. These restrictions can be permanent or temporary. Nautical charts issued by the National Oceanic and Atmospheric Administration (NOAA) include these federally designated zones and areas. Operators of private and commercial vessels have a duty to abide by maritime regulations administered by the U.S. Coast Guard. The Navy's safety measures ensure public health and safety primarily through standard operating procedures to minimize or avoid civilian exposure to training and testing activities.

In accordance with Title 33 C.F.R. 72, *Marine Information*, the U.S. Coast Guard and the Department of Homeland Security inform private and commercial vessels about temporary closures via NTMs, which provide information about durations and locations of closures because of activities that are hazardous to surface vessels. Halting marine traffic is typically not required as a safety measure for private and commercial vessels. In cases where certain activities involve navigational hazards, such as explosive ordnance disposal (EOD), the Navy coordinates with the U.S. Coast Guard to issue NTMs. In other cases, NTMs identify locations of planned Navy activities and alert the public to the need to avoid those locations. During any potentially hazardous surface activity at the Quinault Range Site, public safety is ensured by coordinating with Naval Air Station (NAS) Whidbey Island. Broadcast notices on maritime frequency radio, weekly publications by the appropriate U.S. Coast Guard Navigation Center, and global positioning system navigation charts disseminate these navigational warnings.

3.13.2.1.2 Airspace

Most of the airspace in the Study Area is accessible to general aviation (recreational, private, corporate) and commercial aircraft. Like waterways, however, some areas are temporarily off limits to civilian and commercial use. The Federal Aviation Administration has established Special Use Airspace—airspace of defined dimensions within which activities must be confined because of their nature or within which limitations may be imposed upon aircraft operations that are not part of those activities (Federal Aviation Administration 2011). Special Use Airspace in the Study Area includes the following:

- **Restricted Airspace:** Airspace designated under 14 CFR Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and instrument flight rules/visual flight rules operations in the area may be authorized by the controlling air traffic control facility when it is not being utilized by the using agency.
- **Military Operations Areas:** Airspace established outside of Class A airspace area (surface to but not including 18,000 ft. mean sea level) to separate or segregate certain nonhazardous military activities from instrument flight rules traffic and to identify for visual flight rules traffic where these activities are conducted.
- **Warning Areas:** Airspace of defined dimensions extending from 3 or 12 nm outward from the coast of the United States, that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning area is to warn nonparticipating pilots of the potential danger.

Air Traffic Control Assigned Airspace is defined by the Federal Aviation Administration. This airspace is used to contain specified activities, such as military flight training, that are segregated from other instrument flight rules air traffic.

Notices to Airmen (NOTAMs) are created and transmitted by government agencies and airport operators to alert aircraft pilots of any hazards en route to or at a specific location. The Federal Aviation Administration issues NOTAMs to disseminate information on upcoming or ongoing military exercises with airspace restrictions. Operators of civilian aircraft are responsible for being aware of restricted airspace and any NOTAMs that are in effect. Pilots have a duty to abide by aviation rules as administered by the Federal Aviation Administration.

Weather conditions dictate whether aircraft (general aviation, commercial, or military) can fly under visual flight rules or whether instrument flight rules are required. Under visual flight rules, the weather is favorable and the pilot is required to remain clear of clouds by specified distances to ensure separation from other aircraft under the concept of see and avoid. Pilots flying under visual flight rules must be able to see outside the cockpit, control the aircraft's attitude, navigate, and avoid obstacles and other aircraft based on visual cues. Pilots flying under visual flight rules assume responsibility for their separation from all other aircraft and are generally not assigned routes or altitudes by air traffic control. During unfavorable weather, pilots must follow instrument flight rules. Factors such as visibility, cloud distance, cloud ceilings, and weather phenomena cause visual conditions to drop below the minimums required to operate by visual flight referencing. Instrument flight rules are the regulations and restrictions a pilot must comply with when flying in weather conditions that restrict visibility. Pilots can fly under instrument flight rules in visual flight rules weather conditions; however, pilots cannot fly under visual flight rules in instrument flight rules weather conditions.

3.13.2.2 Safety and Inspection Procedures

During training and testing, Navy policy is to ensure the safety and health of personnel and the general public (U.S. Department of the Navy 2011a). The Navy achieves these conditions by considering a location when planning activities, scheduling and notifying potential users of an area, and ensuring that an area is clear of nonparticipants. The Navy also has a proactive and comprehensive program of compliance with applicable standards and implementation of safety management systems.

3.13.2.2.1 Offshore Area

The Pacific Northwest OPAREA, including the surf zone access area of the Quinault Range Site at Pacific Beach, comprises the Offshore Area. The area of interest for assessing potential impacts on public health and safety is the U.S. territorial waters; therefore, only the surf zone access area is considered here. As discussed in Section 3.13.1.1, training or testing activity in the coastal area has the potential to affect the public because of the concentration of public activities. When planning a training or testing event, the Navy considers proximity of the activity to public areas in choosing a location. Important factors considered include the ability to control access to an area; schedule (time of day, day of week); frequency, duration, and intensity of activities; range safety procedures; operational control of activities or events; and safety history.

The Federal Aviation Administration and the U.S. Coast Guard issue NOTAMs and NTMs, respectively. The Navy works closely with the Seattle Air Route Traffic Control Center (Seattle Center) for scheduling and control. Airspace scheduling and management of Warning Area (W)-570 and W-93 in the Pacific Northwest OPAREA are handled by the U.S. Air Force.

Most fleet training activities are conducted in the Pacific Northwest OPAREA. Testing conducted by Naval Sea Systems Command (NAVSEA) in the Offshore Area is limited torpedo testing activities and Naval Undersea Warfare Center (NUWC) Division, Keyport activities in the Quinault Range Site. Both sea- and air-based testing activities occur in this area.

During training and testing activities in the Study Area, the Navy ensures that the appropriate safety zone is clear of nonparticipants before engaging in certain activities, such as firing weapons. Inability to obtain a “clear range” could cause an event to be delayed, cancelled, or relocated. Navy procedures ensure public safety during Navy activities that otherwise could harm nonparticipants. Navy practices employ the use of sensors and other devices (e.g., radar) to ensure public health and safety while conducting training and testing activities. The following subsections outline the current requirements and practices for human safety as they pertain to range safety procedures, range inspection procedures, exercise planning, and scheduling and coordinating procedures for the Navy.

Training activities comply with the *Northwest Training Range Complex User’s Manual* (NASWHIDBEYINST 3770.1F, U.S. Department of the Navy 2012), which prescribes a thorough environmental and safety review for all activities before being conducted. This manual incorporates guidance and outlines safety precautions and procedures that apply to range users including, but are not limited to, the following:

- The operational commander conducting an exercise shall be satisfied that the range is clear before beginning the exercise.
- Surface or air firing exercises shall be suspended at any time visual or radar warning indicates the presence of any vessel or aircraft within firing range.
- A sufficient number of qualified Lookouts shall be posted during all firing exercises.

- During surface gunnery exercises involving a towed target, two-way communications must be maintained between the firing unit and the towing vessel.
- Users shall be responsible for separation of their units from other air units, both military and civilian.
- Aircraft carrying service or practice ordnance shall avoid passing over ships.

Training and testing activities in the W-237A airspace and seaspace are scheduled and coordinated with NAS Whidbey Island and Commander Submarine Force. The Quinault Range Site is within the Pacific Northwest OPAREA that underlies W-237A and has a mile-wide stretch of surf zone at Pacific Beach.

NAVSEA testing activities in the Offshore Area are conducted in accordance with safety guidance. For the most part, Naval Air Systems Command (NAVAIR) conducts its testing activities in the same way the fleet conducts its training activities. Therefore, the same safety planning and procedures implemented for training activities in the Study Area apply to NAVAIR testing activities that are proposed for the Pacific Northwest OPAREA. Use of the W-237 range is coordinated through Range Schedules at NAS Whidbey Island, which would request the issuing of a NOTAM for air events. For surface events, the *Northwest Training Range Complex User's Manual* states NTMs are the responsibility of the scheduling entity (U.S. Department of the Navy 2012). Range users are responsible for their own range clearance and de-confliction prior to any live fire events.

3.13.2.2.2 Inland Waters

Washington State inland waters include the Strait of Juan de Fuca to its mouth and the Puget Sound region. The Keyport Range Site, Dabob Bay Range Complex (DBRC) Site, Carr Inlet OPAREA, Navy 3 and Navy 7 OPAREAs, and pierside locations are all within the inland waters of Washington State. Two EOD ranges are in the Inland Waters: Hood Canal EOD Range and Crescent Harbor EOD Range.

The Navy uses specific locations in the Inland Waters for both training and testing. Although it is not a restricted area, the Navy limits or restricts access to Crescent Harbor as a safety protocol during mine warfare training. Access to pierside locations is also restricted. Training or testing activities in these inland areas have the potential to affect the public because of the concentration of public activities.

Training exercises within the Washington State inland waters of the Study Area are conducted in accordance with the *Northwest Training Range Complex User's Manual* (U.S. Department of the Navy 2012). The precautions for public health and safety include, but are not limited to, the following:

- Training exercises can only occur when all nonparticipating vessels and persons are clear of the area.
- Underwater demolition training is authorized only in the designated EOD ranges and must observe 700-yard (yd.) (640 m) radius exclusion zones around the detonation site.

NUWC Division Keyport's water-based test activities within the Washington State inland waters of the Study Area are conducted in compliance with NUWC Division Keyport safety guidance to protect the health and safety of the public. The precautions for public health and safety include, but are not limited to, the following:

- NUWC Division Keyport's safety policy is to observe every reasonable precaution in the planning and execution of all activities to prevent injury to people and damage to property.

- Access to the shoreline and pier at NUWC Division Keyport is heavily restricted, and security police personnel are posted at the main gate for additional security. Guards patrol the perimeter of the base, including the shoreline.

Procedures to initiate active sonar transmission operations pierside at Puget Sound Naval Shipyard and Intermediate Facility and at NAVBASE Kitsap Bangor are provided in Puget Sound Naval Shipyard and Intermediate Maintenance Facility Instruction (PSNS&IMFINST) 10552.1A, *Active sonar transmission operations* (U.S. Department of the Navy 2009). The Intermediate Maintenance Facility also does testing at Naval Station Everett. Because the area is restricted, there is no safety risk to the public.

The Navy performs a thorough safety review before conducting any testing activities in Inland Waters. Other procedures to ensure public safety include communicating activities to tribes, regulators, and the public. The Navy operates in cooperation with local maritime activities and rarely requires completely restricted access from OPAREAs.

Testing sites within Puget Sound have shore-to-shore surveillance capability because of the proximity of land on both sides. This provides the Navy a unique opportunity to implement highly effective visual surveillance procedures for public health and safety. Navy personnel on guard boats may advise nonmilitary vessel operators of test restrictions, request that they shut off their engines for a short time to eliminate acoustical interference during noise-sensitive testing, or restrict them from entering the testing area until the activity is completed.

The Keyport Range Site is charted as a restricted area on NOAA Navigation Chart 18446. The Dabob Bay and Hood Canal restricted areas are charted as Naval Operating Areas on NOAA Navigation Chart 18458. These designations help ensure public safety by promoting public awareness to avoid training and testing areas. In addition, the U.S. Coast Guard has published a final rule establishing protection zones extending 500 yd. (457 m) around all Navy vessels in navigable waters of the U.S. and within the boundaries of Coast Guard Pacific Area (32 C.F.R. Part 761), where all vessels must proceed at a no-wake speed when within this 500 yd. protection zone. Nonmilitary vessels are not allowed to approach within 100 yd. (91 m) of a U.S. naval vessel, whether underway or moored, unless authorized by an official patrol.

The Navy maintains yellow, white, and red lights to warn nonmilitary craft of the status of Navy activities within the Dabob Bay portion of the DBRC Site. Red or alternating white and red lights indicate that range activities involving critical measurements are in progress, engines should be stopped until red beacons have been shut off to indicate the test is completed, and advice of Navy personnel on guard boats should be followed when in or near the range site. Typically, boat passage is permitted between tests when the yellow beacons are operating. The descriptions of the lights are posted at local boat ramps and marinas and are clearly indicated on NOAA Nautical Chart 18458.

Public use restrictions associated with Carr Inlet are codified in U.S. Code Title 33 § 334.1250. The area is used as an acoustic range for research studies and special noise trials; no explosives are used. No marine craft of any type shall at anytime approach or remain within 100 yd. (91 m) of the hydrophone buoys. No vessel shall, at any time, anchor or tow a drag of any kind within 1,000 yd. (914 m) of the buoy testing area. The remainder of the area shall be open to navigation at all times except when the range is in use or when hydrophones are being calibrated. Commercial traffic to points within Carr Inlet and through Carr Inlet to adjacent waters will be permitted free access and egress by marine band radio or telephone to Carr Inlet Range Control as far in advance as possible of the time they enter the area. The

Navy shall promptly suspend operations when necessary to permit the passage of such traffic. Insofar as possible, the schedule of operations giving the days the range will be in use for each forthcoming month will be published in local newspapers and in the local U.S. Coast Guard NTM.

3.13.2.2.3 Western Behm Canal, Alaska

Five restricted areas are established (33 C.F.R. § 334) in Behm Canal to ensure public safety and successful completion of mission activities at SEAFAC. The restricted areas provide the Navy with a means to control access to the testing area. In addition, the Navy's standard operating procedures outlined above help to ensure health and safety.

Testing areas are monitored from the shore facility by radar electronically and visually. Radio contact for alert advisories is established with vessels that could be subject to unsafe conditions. Test area lights alert local traffic when SEAFAC is operational, and vessels must coordinate their passage with the SEAFAC facility control officer. The U.S. Coast Guard may also provide support to protect public safety.

3.13.2.3 Aviation Safety

Navy procedures on planning and managing Special Use Airspace are provided in Chief of Naval Operations Instruction (OPNAVINST) 3770.2K, *Airspace Procedures and Planning Manual* (U.S. Department of the Navy 2007). Scheduling and planning procedures for both training and testing air operations in the Study Area are issued through NAS Whidbey Island.

To avoid excessive exposures to electromagnetic energy during electronic warfare activities, military aircraft are operated in accordance with standard operating procedures that establish minimum separation distances between electromagnetic energy emitters and people, ordnance, and fuels (U.S. Department of Defense 2009). Current practices are in place to protect the public from electromagnetic radiation hazards.

Aircrews involved in a training or testing exercise are aware that nonparticipating aircraft and ships are not precluded from entering the area and may not comply with NOTAMs or NTMs. Aircrews are required to maintain a continuous lookout for nonparticipating aircraft while operating in warning areas under visual flight rules. A qualified safety officer is assigned to each event or exercise and can terminate activities if unsafe conditions exist. In general, aircraft carrying ordnance are not allowed to fly over surface vessels.

3.13.2.4 Submarine Navigation Safety

Submarine crews use various methods to avoid collisions while they are surfaced, including visual and radar scanning, acoustic depth finders, and state-of-the-art satellite navigational systems. When submerged submarines transit, they use all available ocean navigation tools, including inertial navigation charts that calculate position based on the submerged movements of the submarine. The surface is scanned for the presence of nonparticipating vessels before and during activities. Training and testing activities are delayed, cancelled, or relocated if range areas are not clear of nonparticipants. Procedures for safely transitioning to the surface include vertical separation of at least 100 ft. (30.5 m) between the top of a submarine's sail and the depth of a surface ship's keel and at least a 1,500 yd. (1,372 m) horizontal separation from other vessels. Areas with surface vessels can then be avoided to protect both the submarines and surface vessels.

3.13.2.5 Surface Vessel Navigational Safety

The Navy practices the fundamentals of safe navigation; this policy applies to all areas in the Study Area. While in transit, Navy surface vessel operators are alert at all times, use extreme caution, use state-of-the-art satellite navigational systems, and are trained to take proper action if there is a risk. Surface vessels are also equipped with trained and qualified Navy Lookouts. Individuals trained as Lookouts have the necessary skills to detect objects or activity in the water that could be a risk for the vessel.

3.13.2.5.1 Offshore Area

Before launching a weapon or sensors and other packages, vessels are required to determine that all safety criteria have been satisfied, the weapons and target recovery conditions are satisfactory, and recovery helicopters and vessels are ready to be employed.

3.13.2.5.2 Inland Waters

For specific testing activities, such as unmanned surface and underwater vehicle testing, a support boat would be used near the testing to ensure safe navigation. Before firing or launching a weapon, Navy surface vessels are required to determine that all safety criteria have been satisfied. When applicable, the surface vessel would use aircraft and other vessels to aid navigation. In accordance with Navy instructions presented in this chapter, safety and inspection procedures ensure consideration for public health and safety.

3.13.2.5.3 Western Behm Canal, Alaska

For specific activities, surface craft conduct visual surveillance before and during testing activities. The facility control officer in the SEAFAC facility operations building maintains visual surveillance of the site. In accordance with Navy instructions presented in this chapter, safety and inspection procedures ensure consideration of public health and safety.

3.13.2.6 Sound Navigation and Ranging Safety

3.13.2.6.1 Offshore Area

Sonar training activities are conducted in accordance with the *Northwest Training Range Complex User's Manual* (U.S. Department of the Navy 2012). Among the various safety precautions, sonar is operated at the lowest practicable level required to meet tactical training objectives, and operators ensure that the safety zone radius around the sound source is clear prior to start up or restart of active sonar.

3.13.2.6.2 Inland Waters

Surface vessels and submarines may use active sonar at the pierside locations listed in Chapter 2 (Description of Proposed Action and Alternatives). Procedures for NAVSEA to initiate active sonar transmission activities pierside are provided in PSNS&IMFINST 10552.1A, *Active sonar transmission operations* (U.S. Department of the Navy 2009). Procedures for training activities in the Inland Waters can be found in the *Northwest Training Range Complex User's Manual* (U.S. Department of the Navy 2012). To ensure safe and effective sonar use, the Navy applies the same safety procedures for pierside sonar use described for sonar use in the presence of Navy divers.

The *U.S. Navy Dive Manual*, Appendix 1A, Safe Diving Distances from Transmitting Sonar, is the Navy is governing document for protecting divers during active sonar use (U.S. Department of the Navy 2011b). Precautions are taken to ensure that divers or swimmers are not exposed to sonar. Before the use of

active sonar, Navy observers ensure that there are no non-Navy divers or swimmers in the water within a safe standoff distance. The safe standoff distances vary with sonar and diver characteristics. This instruction provides procedures for calculating safe distances from active sonar, as derived from experimental and theoretical research conducted at the Naval Submarine Medical Research Laboratory and the Navy Experimental Diving Unit. Safety distances vary based on conditions that include diver attire, type of sonar, and duration of time in the water. Some safety procedures include onsite measurements during testing activities to identify an exclusion area for nonparticipating swimmers and divers (e.g., recreational and shellfish harvest divers).

3.13.2.7 Explosive Ordnance Detonation Safety

3.13.2.7.1 Offshore Area and Inland Waters

Pressure waves from underwater detonations can pose a physical hazard in surrounding waters. Before conducting an underwater training or testing activity, Navy personnel establish an appropriately sized exclusion zone to avoid exposure of nonparticipants to the harmful intensities of pressure. The *U.S. Navy Dive Manual*, Chapter 2, Underwater Physics, provides procedures for determining safe distances from underwater explosions (U.S. Department of the Navy 2011b). In accordance with training and testing procedures for safety planning related to detonations (U.S. Department of the Navy 2011a), the Navy uses the following general and underwater detonation procedures:

- Navy personnel are responsible for ensuring that impact areas and targets are clear before commencing hazardous activities.
- The use of underwater ordnance must be coordinated with submarine operational authorities.
- Aircraft or vessels expending ordnance shall not commence firing without permission of the range safety officer or test safety officer for their specific range area.
- Firing units and targets must remain in their assigned areas, and units must fire in accordance with current safety instructions.
- Detonation activities will be conducted during daylight hours.

3.13.2.8 Weapons Firing and Ordnance Expenditure Safety

3.13.2.8.1 Offshore Area and Inland Waters

In accordance with safety and inspection procedures (U.S. Department of the Navy 2011a), any unit firing or expending ordnance shall ensure that all possible safety precautions are taken to prevent accidental injury or property damage. The officer conducting the exercise shall permit firing or jettisoning of aerial targets only when the area is confirmed to be clear of nonparticipating units, both civilian and military.

Safety is a primary consideration for all training and testing activities. The range must be able to safely contain the hazard area of the weapons and equipment employed. The type of activity determines the size of the buffer zone. For activities with a large hazard area, special sea and air surveillance measures are implemented to ensure that the area is clear before activities commence. Before aircraft can drop ordnance, they are required to make a preliminary pass over the intended target area to ensure that it is clear of boats, divers, or other nonparticipants. Aircraft carrying ordnance are not allowed to fly over surface vessels.

Training and testing activities are delayed, moved, or cancelled if there is a question about the safety of the public. Target areas must be clear of nonparticipants before conducting training and testing. If a restriction is in place and not being observed during a NAVSEA testing activity, the nonparticipant will be

asked to move out of the safety buffer area. However, the NAVSEA activity will be delayed, moved, or cancelled if the restriction is not observed. When using ordnance with flight termination systems (which terminate the flight of airborne missiles or launch vehicles when they veer from their targeted path), the Navy is required to follow standard operating procedures to ensure public health and safety. In those cases where a weapons system does not have a flight termination system, the size of the target area that needs to be clear of nonparticipants is based on the flight distance of the weapon plus an additional distance beyond the system's performance capability.

3.13.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact public health and safety. In this section, each public health and safety stressor is introduced, analyzed by alternative, and analyzed for relevant training and testing activities. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including the number of events and ordnance expended). Tables F-1 and F-2 in Appendix F (Training and Testing Activities Matrices) describe the warfare areas and associated stressors that were considered for analysis of public health and safety. The stressors vary in intensity, frequency, duration, and location within the Study Area. Four stressors are applicable to public health and safety:

- Underwater energy
- In-air energy
- Physical interactions
- Secondary impacts from sediment and water quality changes

Alternatives 1 and 2 provide for inclusion of activities pierside, in Puget Sound, and at the Carr Inlet OPAREA, as described in Chapter 2 (Description of Proposed Action and Alternatives). Alternatives 1 and 2 would adjust locations and frequency of training and testing activities but would employ existing safety procedures and standard operating procedures such that no new or additional risks to the public health and safety would be created.

Potential public health and safety impacts were evaluated assuming continued implementation of the Navy's current safety procedures for each training and testing activity or group of similar activities. Generally, the greatest potential for the proposed activities to be co-located with public activities would be in coastal areas because the intensity of commercial and recreational activities declines with increasing distance from the coast.

Training and testing activities in the Study Area are conducted in accordance with guidance provided in *Northwest Training Range Complex User's Manual* (NASWHIDBEYINST 3770.1F), *Navy Safety and Occupational Health Program Manual* (OPNAVINST 5100.23G CH-1), *Active sonar transmission operations* (PSNS&IMFINST 10552.1A, U.S. Department of the Navy 2009), range operating procedures, SEAFAC standard operating procedures, and NUWC Division Keyport safety guidance. These manuals and instructions provide operational and safety procedures for all normal Navy events. They also provide information to range users that is necessary to operate safely and avoid affecting nonmilitary activities such as shipping, recreational boating, diving, and commercial or recreational fishing. Ranges are managed in accordance with standard operating procedures that ensure public health and safety. Current requirements and practices (e.g., standard operating procedures) designed to prevent public health and safety impacts discussed in Section 3.13.2 are incorporated in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Table 3.13-1 contains the number of components or activities for each of the stressors with respect to their location and changes among the alternatives. The specific analysis of the training and testing activities presented in this section considers relevant components and associated data with the geographic location of the activity and the resource. Training activities are not proposed in the Western Behm Canal; therefore, only activities in the Offshore Area and the Inland Waters will be analyzed under Training Activities.

Table 3.13-1: Stressor Table for Public Health and Safety

Component	Area	Number of Components or Activities					
		No Action Alternative		Alternative 1		Alternative 2	
		Training	Testing	Training	Testing	Training	Testing
Underwater Energy							
Sonar and other active sources	Offshore Area	See Table 3.0-10					
	Inland Waters						
	W. Behm Canal						
Explosives	Offshore Area	378	0	292	148	502	164
	Inland Waters	4	0	42	0	42	0
	W. Behm Canal	0	0	0	0	0	0
In-Air Energy							
Various sources of electromagnetic energy	Offshore Area	Qualitative					
	Inland Waters						
	W. Behm Canal						
Physical Interactions							
Activities including aircraft	Offshore Area	3,826	2	6,471	74	6,471	84
	Inland Waters	124	2	127	20	127	25
	W. Behm Canal	0	0	0	0	0	0
Activities including vessels	Offshore Area	996	37	1,096	138	1,096	162
	Inland Waters	4	337	53	582	53	640
	W. Behm Canal	0	28	0	60	0	83
Activities including in-water devices	Offshore Area	429	40	484	154	484	183
	Inland Waters	0	379	1	648	1	716
	W. Behm Canal	0	0	0	0	0	0
Military expended materials	Offshore Area	189,668	621	196,888	2,511	196,888	2,764
	Inland Waters	8	446	85	517	85	568
	W. Behm Canal	0	0	0	0	0	0
Secondary Stressors							
Sediment and water quality changes	Offshore Area	Qualitative					
	Inland Waters						
	W. Behm Canal						

3.13.3.1 Underwater Energy

Underwater energy can come from acoustic sources or underwater explosions. Active sonar, underwater explosions, and vessel movements all produce underwater acoustic energy. A negligible amount of energy from sound will travel from air to water during aircraft overflights because of

refraction. Electromagnetic energy can enter the water from mine warfare training devices and from unmanned underwater systems. The potential for the public to be exposed to this stressor would be limited to individuals, such as recreational swimmers or self-contained underwater breathing apparatus (SCUBA) divers, that are under water and within unsafe proximity of a training or testing event.

Non-Navy swimmers and SCUBA divers (e.g., recreational and shellfish harvest divers) are not expected to be near Navy pierside locations (which include shipyards) because access to these areas is controlled for safety and security reasons. Locations of popular offshore diving spots are well documented, and dive boats (typically well marked) and diver-down flags would be visible from the vessels conducting the training and testing. Swimmers and divers are not expected to be near training and testing locations where active sonar activities and underwater explosions would occur because of the strict procedures for clearance of nonparticipants before conducting activities. Therefore, co-occurrence of divers and Navy activities is unlikely.

The *U.S. Navy Dive Manual* (U.S. Department of the Navy 2011b) prescribes safe distances for divers from active sonar sources and underwater explosions. Safety precautions specified in DoD Instruction 6055.11 (U.S. Department of Defense 2009) would be used as the standard safety buffers for underwater energy to protect public health and safety. If unauthorized personnel were detected within the exercise area, the activity would be promptly halted until the area was again clear and secure. Therefore, the public is unlikely to be exposed to underwater energy at Navy pierside locations, in training or testing areas, or in ports.

Many of the proposed activities generate underwater acoustic energy; however, not all sources rise to the level of consideration in this EIS/OEIS as a risk to public health and safety. Swimmers or divers (e.g., recreational and shellfish harvest divers) might intermittently hear ship noise or underwater acoustic energy from aircraft overflights if they are near a training or testing event, but public health and safety would not be affected because aircraft or ship movement near an individual would be transitory. Because of the transitory nature of aircraft or ship movement, potential impacts on public health and safety of underwater acoustic energy from vessel movements and aircraft overflights would not be substantial and are not analyzed in further detail.

Active sonar and underwater explosions are the only sources of underwater acoustic energy evaluated for potential impacts on public health and safety. Various training and testing activities result in underwater acoustic activity; these activities are listed in Section 3.0.5.3.1 (Acoustic Stressors). Activities beyond U.S. territorial waters are not considered in the analysis of potential impacts on public health and safety, including most anti-surface warfare activities associated with weapons firing and anti-submarine warfare events that occur beyond 12 nm from shore.

The impacts on public health and safety from underwater energy depend on many factors. The effects of active sonar on humans vary with the sonar frequency. Of the four types of sonar (very high-, high-, mid-, and low-frequency), mid-frequency and low-frequency sonar have the greatest potential to impact humans because of the range of human hearing. Underwater explosives cause a physical shock front that compresses the explosive material, and the pressure wave then passes into the surrounding water. Generally, the pressure wave would be the primary cause of injury. The effects of an underwater explosion depend on several factors, including the size, type, and depth of the explosive charge and where it is in the water column.

3.13.3.1.1 No Action Alternative

3.13.3.1.1.1 Training Activities

Offshore Area

Under the No Action Alternative, active sonar training activities would continue at current levels and within the established Northwest Training Range Complex. Most of the active sonar activities are conducted beyond 12 nm in the Pacific Northwest OPAREA. Activities involving underwater explosions would continue at current levels within the Northwest Training Range Complex; however, most activities involving weapons firing and ordnance use would be conducted beyond 12 nm from shore (outside U.S. territorial waters).

Because most of these activities will occur beyond 12 nm from shore, and because the implementation of strict operating procedures will protect public health and safety, the potential for training activities emitting underwater energy to impact public health and safety under the No Action Alternative is low. These operating procedures include ensuring clearance of the area before commencing training activities involving underwater energy. Because the potential for impacts are low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Current locations for underwater explosions include specific training areas in the underwater training ranges at Crescent Harbor and Hood Canal. The EOD activities would include four training events per year: two events at Crescent Harbor EOD training box with net explosive weight at a maximum of 2.5 pounds (lb.) (1.1 kilograms [kg]), and two events in the Hood Canal EOD training area with net explosive weight at a maximum of 1.5 lb. (0.68 kg). Extensive onsite surveillance to protect threatened and endangered species would also protect public safety and health. Because of the Navy's safety procedures, the potential for training activities emitting underwater energy to impact public health and safety under the No Action Alternative is low. Because the potential for impacts are low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.1.1.2 Testing Activities

Offshore Area

Under the No Action Alternative, active acoustic testing activities would continue at current levels. No testing activities involving underwater explosions would be conducted under the No Action Alternative.

Surf zone activities at Pacific Beach Safety would be conducted after the area is free of nonparticipants. Standard operating procedures and visual surveillance are also implemented. The surf zone would be kept clear of nonparticipants prior to, during, and immediately after each test to avoid potential safety issues.

NAVAIR testing activities are not included in the No Action Alternative.

Because most of these activities will occur beyond 12 nm from shore and because the implementation of strict operating procedures would protect public health and safety, the potential for testing activities to impact public health and safety under the No Action Alternative is low. These operating procedures include ensuring clearance of the area before commencing testing activities involving underwater

energy. Because the potential for impacts is low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Under the No Action Alternative, sonar use for NUWC Division Keyport unmanned underwater devices and miscellaneous testing would occur at DBRC Site and Keyport Range Site. Because of the Navy's safety procedures, the potential for testing activities emitting underwater energy to impact public health and safety is low. Because the potential for impacts is negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

The acoustic sensors at SEAFAC are passive; active acoustic sources are used for communications, for range calibration, and to provide position information for units operating submerged on the range. Activities would be conducted in the five restricted areas within Western Behm Canal. The restricted areas provide for vessel and public safety, lessen acoustic encroachment from nonparticipating vessels, and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. Acoustic measurements would be conducted at current levels, with 28 events per year at SEAFAC. Proposed activities include surface vessel acoustic measurement, underwater vessel acoustic measurement, underwater vessel hydrodynamic performance measurement, component system testing, and measurement system repair and replacement. Because of the Navy's safety procedures, the potential for testing activities to impact public health and safety is low. Because the potential for impacts is low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Under Alternative 1, the number of events at SEAFAC would increase above current levels. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because the potential for impacts are low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.13.3.1.2 Alternative 1

3.13.3.1.2.1 Training Activities

Offshore Area

The proposed adjustments to baseline training activities under Alternative 1 include an increase in active sonar training and a decrease in activities involving underwater explosions, including sinking exercises, as described in Tables 3.0-11 and 3.13-1. However, most of these activities would occur beyond 12 nm from shore. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure training areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because the potential for impacts are low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Alternative 1 would adjust and introduce training activities, as described in Tables 3.0-11 and 3.13-1. None of the additional activities include live fire. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because the potential for impacts are low, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.1.2.2 Testing Activities

Offshore Area

The proposed adjustments to baseline testing activities under Alternative 1 include increases in active sonar testing and activities involving underwater explosions, as described in Tables 3.0-11 and 3.13-1. The frequency of active sonar testing activities in the Quinault Range Site would increase over the No Action Alternative. The number of components or activities involving the use of explosives would increases from none in the Offshore Area to 148. The Navy's existing safety procedures would ensure that the potential for these activities to impact public health and safety would be low.

NAVAIR would conduct activities to evaluate the sensors and systems (sonobuoys) used by maritime patrol aircraft and improved extended echo ranging sonobuoys in the Pacific Northwest OPAREA. These NAVAIR activities would likely be conducted outside U.S. territorial waters. NAVSEA testing activities would increase under Alternative 1 but would continue to occur beyond 12 nm from shore. NUWC Division Keyport activities such as torpedo testing, countermeasures testing, and other miscellaneous tests would increase in the Quinault Range Site. These tests use active acoustic systems. The amount of underwater energy, including sonar, emitted by these activities would increase over the No Action Alternative. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Sonar use for NUWC Division Keyport testing activities would be similar as described under the No Action Alternative. NAVSEA pierside testing while ships are in port at Navy piers would occur at NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett. Naval Surface Warfare Center, Carderock Division, Detachment Puget Sound would conduct acoustic testing activities in Hood Canal and resume testing activities at Carr Inlet OPAREAs. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

The proposed adjustment to Alternative 1 testing activities includes an increased frequency of operations at SEAFAC. The small increase would allow for future testing requirements. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health

and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.13.3.1.3 Alternative 2

3.13.3.1.3.1 Training Activities

Offshore Area

The proposed adjustments to baseline training activities under Alternative 1 include increases in active sonar training and activities involving underwater explosions, including sinking exercises, as described in Tables 3.0-11 and 3.13-1. However, most of these activities would occur beyond 12 nm from shore. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure training areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

The proposed adjustments to Alternative 1 training activities include increasing the integrated maritime homeland defense/security mine countermeasures exercise frequency to an annual event. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.1.3.2 Testing Activities

Offshore Area

The proposed adjustments to the levels and types of testing include an increased frequency of operations by NUWC Division Keyport for NAVSEA and by NAVAIR. The proposed activities under Alternative 2 are similar to Alternative 1, as described in Tables 3.0.11 and 3.13-1. The proposed testing activities involving underwater explosions are similar to Alternative 1, which would occur within established ranges and locations. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

The proposed adjustments to Alternative 1 testing activities include an increase in the number of events for NUWC Division Keyport unmanned underwater vehicles testing and miscellaneous testing activities. The small increase would allow for future testing requirements. The frequency of pierside sonar testing at NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett would increase under Alternative 2. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not

likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

The proposed adjustments to Alternative 2 testing activities includes an increased frequency of operations at SEAFAC. The small increase would allow for future testing requirements. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would not likely increase. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.13.3.2 In-Air Energy

In-air energy stressors include sources of electromagnetic energy and lasers. As described in Section 3.0.5.3.2.1 (Electromagnetic), emission of electromagnetic energy by magnetic influence mine neutralization systems occur only in training activities in Inland Waters. As described in Section 3.0.5.3.2.2 (Lasers), only low-energy lasers are used under the Proposed Action. Low-energy lasers are used to illuminate or designate targets, to guide weapons, and to detect or classify mines. Lasers are only used to guide bombing exercises for training in the Offshore Area. Laser safety requirements for aircraft require verification that target areas are clear before commencement of the exercise. In addition, during actual laser use, the aircraft run-in headings are restricted to preclude inadvertent lasing of areas where the public may be present.

3.13.3.2.1 No Action Alternative

3.13.3.2.1.1 Training

Offshore Area

Thirty events are proposed per year. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, there is no difference among the alternatives and no difference in the types of impacts as described in Section 3.0.5.3.2.2 (Lasers). Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

There are no training activities that include in-air energy.

3.13.3.2.1.2 Testing

There are no testing activities that include in-air energy.

3.13.3.2.2 Alternative 1

3.13.3.2.2.1 Training

Offshore Area

Thirty events are proposed per year. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, there is no difference among the alternatives and no difference in the types of impacts as described in Section 3.0.5.3.2.2 (Lasers). Because impacts are negligible, no disproportionately high and adverse

effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Alternative 1 would introduce the use of electromagnetic energy under maritime homeland defense/security mine countermeasures. One event is proposed every other year (three in 5 years). Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.2.2.2 Testing

There are no testing activities that include in-air energy.

3.13.3.2.3 Alternative 2

3.13.3.2.3.1 Training

Offshore Area

Thirty events are proposed per year. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, there is no difference among the alternatives and no difference in the types of impacts as described in Section 3.0.5.3.2.2 (Lasers). Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Alternative 2 would increase in frequency to one event each year. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.2.3.2 Testing

There are no testing activities that include in-air energy.

3.13.3.3 Physical Interactions

Public health and safety could be impacted by direct physical interactions with Navy activities. Navy aircraft, vessels, targets, munitions, towed devices, seafloor devices, and other expended materials resulting from training and testing activities could have direct physical encounters with recreational, commercial, or institutional aircraft, vessels, and users such as swimmers, divers (e.g., recreational and shell fish harvest divers), and anglers.

Both Navy and private aircraft operate under visual flight rules requiring them to observe and avoid other aircraft. In addition, NOTAMs advise pilots about when and where Navy training and testing activities are scheduled. Finally, Navy personnel are required to verify that the range is clear of nonparticipants before initiating any potentially hazardous activity. Together, these procedures would minimize the potential for adverse interactions between Navy and nonparticipant aircraft. The Navy's

standard operating procedures ensure that private and commercial aircraft traversing the Study Area during training or testing activities do not interact with Navy aircraft, ordnance, or aerial targets.

Both Navy and private vessels operate under maritime navigational rules requiring them to observe and avoid other vessels. In addition, NTMs advise vessel operators about when and where navigational hazards exist because of Navy training and testing activities. Finally, Navy personnel are required to verify that the range is clear of nonparticipants before initiating any potentially hazardous activity. Together, these procedures minimize the potential for adverse interactions between Navy and nonparticipant vessels. The Navy's standard operating procedures ensure that private and commercial vessels traversing the Study Area during training or testing activities do not interact with Navy vessels, ordnance, or surface targets.

Recreational diving within the Study Area takes place primarily at known diving sites such as shipwrecks and reefs. The locations of these popular dive sites are well documented, dive boats are typically well marked, and diver-down flags are visible from a distance. As a result, ships conducting training or testing activities would easily avoid dive sites. Interactions between training and testing activities and divers thus would be minimized, reducing the potential for collisions or ship strikes.

Commercial and recreational fishers could encounter military expended materials that could entangle fishing gear and could pose a safety risk. The Navy would continue to recover targets at or near the surface that were used during training or testing to ensure that they would not pose a collision risk. Unrecoverable pieces of military expended materials are typically small (such as sonobuoys), constructed of soft materials (such as target cardboard boxes), or intended to sink to the bottom after use, so they would not be a collision risk to civilian vessels or equipment. Thus, these targets do not pose a safety risk to individuals using the area for recreation because the public would not likely be exposed to these items before they sank to the seafloor.

As discussed in Section 3.1 (Sediments and Water Quality), a west coast study categorized types of marine debris collected by a trawler during a groundfish survey. Military expended materials categorized as plastic, metal, fabric and fiber, and rubber accounted for 7.4, 6.2, 13.2, and 4.7 percent, respectively, of the total count of items collected. The footprint of military expended materials in the Study Area is discussed in Section 3.3 (Marine Habitats), which concludes that if all military expended materials were placed side by side in the Study Area, the footprint would be approximately 0.04 square nautical mile. Because this footprint is so small relative to the size of the Study Area, recreational and commercial fishers probably would not encounter military expended materials.

Section 3.1 (Sediments and Water Quality) also discussed the low failure rates of munitions, which indicate that most munitions function as intended. Practically all of the munitions are consumed in an exercise, and training ordnance is usually recovered. While fish trawls may encounter undetonated ordnance lying on the ocean floor, such an encounter would be unlikely because the density of munitions in the Study Area is low. Further, activities involving live ordnance occur further offshore, which further reduces the potential for risk. The U.S. Army Corps of Engineers prescribes safety procedures to the public if military munitions are encountered.

The analysis focuses on the potential for a direct physical interaction between the public and an aircraft, vessel, target, underwater devices, or expended training or testing item. All proposed activities have some potential for a direct physical interaction that could pose a risk to public health and safety, so the following analysis is not activity specific. While some of the activities may not pose a potential for a

direct physical interaction (like pierside testing) the platforms used in the activity (aircraft, vessel, towed device) could have a direct physical interaction that could pose a risk. The greatest potential for a physical interaction would be in nearshore areas because of the higher concentration of public activities, leading to a greater potential for co-occurrence.

3.13.3.3.1 No Action Alternative

3.13.3.3.1.1 Training

Offshore Area

The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. The potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Mine warfare activities in Crescent Harbor EOD Range and Hood Canal EOD Range, as well as naval special warfare activities, could impact public health and safety by direct physical interactions. However, the Navy's implementation of strict operating procedures would protect public health and safety from training activities. Because of the implementation of these strict operating procedures, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.3.1.2 Testing

Offshore Area

Additional activities under this alternative that could impact public health and safety by direct physical interactions include torpedo testing and miscellaneous testing in the Quinault Range Site. In-water testing of non-explosive torpedoes, unmanned underwater devices, and anti-submarine warfare activities in the surf zone at Pacific Beach could also impact public health and safety. There is no NAVAIR testing under the No Action Alternative. Because the potential for a physical interaction is not activity specific or location specific, the analysis of the training activities above applies to testing activities under the No Action Alternative. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Testing in the DBRC Site and Keyport Range Site could impact public health and safety by direct physical interactions. Countermeasure materials expended during testing are sought for recovery and test evaluation. Sonobuoys are recovered for further analysis after testing. Torpedoes and unmanned undersea vehicles used for testing do not contain explosives and are recovered for reuse and for performance evaluation. However, materials such as decelerator/parachutes, guidance wires, and ballast weights are expended. Targets may be temporarily deployed and then recovered. Stationery targets may be in the water column either floating suspended or anchored. If there is a navigational

hazard, then an NTM is issued for advisory notice to the public. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

Acoustic measurements would be conducted at current levels with 28 events per year at SEAFAC. Proposed activities include surface vessel acoustic measurement, underwater vessel acoustic measurement, underwater vessel hydrodynamic performance measurement, component system testing, and measurement system repair and replacement. Because of the implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.13.3.3.2 Alternative 1

3.13.3.3.2.1 Training

Offshore Area

Under Alternative 1, the number of events involving aircraft, vessels, and in-water devices would increase from the No Action Alternative (see Table 3.13-1). The amount of military expended materials is expected to decrease from the No Action Alternative. The increased number of aircraft, vessel, and in-water device movements would be conducted under the same safety and inspection procedures as under the No Action Alternative. Under Alternative 1, most activities in the Pacific Northwest OPAREA that could impact public health and safety would likely be conducted outside U.S. territorial waters. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Under Alternative 1, the number of events involving aircraft, vessels, in-water devices, and military expended materials would increase from the No Action Alternative and Alternative 1 (see Table 3.13-1). The proposed adjustments to baseline training activities include anti-surface warfare activities at Crescent Harbor, mine warfare activities in Crescent Harbor EOD Range and Hood Canal EOD Range, and maritime homeland defense/security mine countermeasures exercises inside Puget Sound and Strait of Juan de Fuca. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.3.2.2 Testing

Offshore Area

Under Alternative 1, the number of events involving aircraft, vessels, in-water devices, and military expended materials would increase from the No Action Alternative (see Table 3.13-1). The types and frequency of testing activities in the Offshore Area would increase under Alternative 1. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Under Alternative 1, the number of events involving aircraft, vessels, in-water devices, and military expended materials would increase from the No Action Alternative (see Table 3.13-1). The number of events for testing in the DBRC Site and Keyport Range Site would increase under Alternative 1. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

Under Alternative 1, the number of activities involving vessels would increase over the No Action Alternative (see Table 3.13-1). Under Alternative 1, acoustic measurements would continue to be conducted at SEAFAC in the five restricted areas within Western Behm Canal where the restricted areas provide for vessel and public safety, lessen acoustic encroachment from nonparticipating vessels, and prohibit certain activities that could damage SEAFAC's sensitive in-water acoustic instruments and associated cables. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.13.3.3.3 Alternative 2

3.13.3.3.3.1 Training

Offshore Area

Under Alternative 2, the number of events involving aircraft, vessels, in-water devices, and military expended materials would be the same as Alternative 1 (see Table 3.13-1). The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants.

Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

Inland Waters

Under Alternative 2, the number of events involving aircraft, vessels, in-water devices, and military expended materials would be the same as Alternative 1 (see Table 3.13-1). The only proposed adjustment to Alternative 1 training activities that could impact public health and safety by physical interactions is an increased frequency of maritime homeland defense/security mine countermeasures exercises inside Puget Sound and Strait of Juan de Fuca to an annual event. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of training activities.

3.13.3.3.3.2 Testing

Offshore Area

Under Alternative 2, the number of events involving aircraft, vessels, in-water devices, and military expended materials would increase from the No Action Alternative and is greater than under Alternative 1 (see Table 3.13-1). The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, including procedures to make sure areas are clear of nonparticipants, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Inland Waters

Under Alternative 2, the number of events involving aircraft, vessels, in-water devices, and military expended materials would be greater than under Alternative 1 (see Table 3.13-1). Testing in Inland Waters would increase slightly under Alternative 1. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

Western Behm Canal

Under Alternative 2, the number of activities involving vessels would increase over Alternative 1 (see Table 3.13-1). The proposed adjustment to Alternative 1 testing activities includes an increased frequency of operations at SEAFAC. The potential for direct physical interaction between the public and aircraft, vessels, targets, or expended materials would be similar to baseline conditions due to the continued implementation of strict operating procedures that protect public health and safety, including procedures to make sure areas are clear of nonparticipants. Because of these strict operating

procedures, the potential for impacts on public health and safety would be negligible. Because impacts are negligible, no disproportionately high and adverse effects on any low-income or minority populations would occur as a result of implementation of testing activities.

3.13.3.4 Secondary Impacts

Public health and safety could be impacted in all areas (offshore, inland, and southeast Alaska) of the Study Area if sediment or water quality were degraded. Section 3.1 (Sediments and Water Quality) considered the impacts on marine sediments and water quality of explosives and explosion byproducts, metals, chemicals other than explosives, and other materials (marine markers, flares, chaff, targets, and miscellaneous components of other materials). The analysis determined that neither state nor federal standards or guidelines would be violated by the No Action Alternative, Alternative 1, or Alternative 2. Because these standards and guidelines are structured to protect human health, and the proposed activities do not violate them, no secondary impacts on public health and safety would result from the training and testing activities proposed by the No Action Alternative, Alternative 1, or Alternative 2.

3.13.3.5 Summary of Potential Impacts of All Stressors on Public Health and Safety

Activities described in this EIS/OEIS that could affect public health and safety in offshore, inland, and southeast Alaska portions of the Study Area include those that emit underwater energy, cause physical interactions, or have secondary impacts from changes in sediment or water quality. Under the No Action Alternative, Alternative 1, or Alternative 2, these activities would either be widely dispersed throughout the Study Area or confined to very specific areas. Such activities also are dispersed temporally (i.e., few stressors would be present at the same time). For these reasons, no greater impacts from the combined presence (geographical or temporal) of more than one stressor are expected. The aggregate impact on public health and safety would not observably differ.

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4 Cumulative Impacts

TABLE OF CONTENTS

4 CUMULATIVE IMPACTS 4-1

4.1 INTRODUCTION 4-1
4.2 APPROACH TO ANALYSIS 4-1
4.2.1 OVERVIEW 4-1
4.2.2 IDENTIFY APPROPRIATE LEVEL OF ANALYSIS FOR EACH RESOURCE 4-2
4.2.3 DEFINE THE GEOGRAPHIC BOUNDARIES AND TIMEFRAME FOR ANALYSIS 4-2
4.2.4 DESCRIBE CURRENT RESOURCE CONDITIONS AND TRENDS 4-3
4.2.5 IDENTIFY POTENTIAL IMPACTS OF THE ALTERNATIVES THAT MIGHT CONTRIBUTE TO CUMULATIVE IMPACTS 4-3
4.2.6 IDENTIFY OTHER ACTIONS AND OTHER ENVIRONMENTAL CONSIDERATIONS THAT AFFECT EACH RESOURCE 4-3
4.2.7 ANALYZE POTENTIAL CUMULATIVE IMPACTS 4-4
4.3 OTHER ACTIONS ANALYZED IN THE CUMULATIVE IMPACTS ANALYSIS 4-4
4.3.1 OVERVIEW 4-4
4.3.2 OFFSHORE POWER GENERATION 4-11
4.3.2.1 Marine Hydrokinetic Projects 4-11
4.3.3 RESTORATION, RESEARCH, AND CONSERVATION PROJECTS AND PROGRAMS 4-11
4.3.3.1 Olympic Coast National Marine Sanctuary Management Plan Update 4-11
4.3.4 OTHER MILITARY ACTIVITIES 4-12
4.3.4.1 Surveillance Towed Array Sensor System Low Frequency Active Sonar 4-12
4.3.4.2 United States Coast Guard 4-12
4.3.4.3 Oregon Air National Guard Flight Training 4-12
4.3.4.4 Pile Repair and Replacement Program 4-12
4.3.4.5 Force Protection and Weapons Security Measures 4-13
4.3.4.6 Barge Mooring Project Environmental Assessment/Incidental Harassment Authorization 4-13
4.3.4.7 Waterfront Restricted Area Land-Water Interface, Naval Base Kitsap Bangor 4-13
4.3.4.8 Waterfront Restricted Area Service Pier Extension, Naval Base Kitsap Bangor 4-13
4.3.4.9 Explosives Handling Wharf 1 Maintenance 4-14
4.3.4.10 Electromagnetic Measurement Ranging System, Hood Canal 4-14
4.3.4.11 Breakwater Construction and Pier Demolition at Naval Air Station Whidbey Island 4-14
4.3.4.12 Swimmer Interdiction Security System, Naval Base Kitsap Bangor 4-15
4.3.4.13 Explosives Handling Wharf 2, Naval Base Kitsap Bangor 4-15
4.3.4.14 Tribal Mitigation for Explosive Handling Wharf 2 4-15
4.3.4.15 Transit Protection System Facilities, Naval Base Kitsap Bangor 4-17
4.3.4.16 P-8A Multi-Mission Aircraft 4-17
4.3.4.17 Electronic Attack Squadron Expeditionary Wing Environmental Assessment 4-17
4.3.4.18 United States Department of the Navy Climate Change Roadmap 4-17
4.3.5 ENVIRONMENTAL REGULATIONS AND PLANNING 4-18
4.3.5.1 Coastal and Marine Spatial Planning 4-18
4.3.5.2 Marine Mammal Protection Act Incidental Take Authorizations 4-18
4.3.6 OTHER ENVIRONMENTAL CONSIDERATIONS 4-18
4.3.6.1 Fred Hill Materials Thorndyke Resource (Pit-to-Pier) Project 4-18
4.3.6.2 Hood Canal In Lieu Fee Mitigation Program 4-19
4.3.6.3 Commercial and Recreational Fishing 4-19
4.3.6.4 Maritime Traffic 4-20
4.3.6.5 Shoreline Development 4-20

4.3.6.6 Oceanographic Research 4-20
4.3.6.7 Ocean Noise 4-21
4.3.6.8 Ocean Pollution....4-22
4.3.6.9 Marine Tourism....4-23
4.3.6.10 Commercial and General Aviation 4-24
4.3.6.11 2013 Bremerton Ferry Terminal Construction by the Washington State Department of Transportation 4-24
4.4 RESOURCE-SPECIFIC CUMULATIVE IMPACTS 4-25
4.4.1 RESOURCE AREAS DISMISSED FROM CUMULATIVE IMPACTS ANALYSIS....4-25
4.4.2 SEDIMENTS AND WATER QUALITY 4-25
4.4.3 AIR QUALITY....4-26
4.4.4 CLIMATE CHANGE....4-27
4.4.4.1 Greenhouse Gases 4-27
4.4.4.2 Cumulative Greenhouse Gas Impacts....4-29
4.4.5 MARINE HABITATS 4-30
4.4.6 MARINE MAMMALS 4-30
4.4.6.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts 4-30
4.4.6.2 Impacts of Other Actions 4-31
4.4.6.3 Coastal Development....4-34
4.4.6.4 Cumulative Impacts on Marine Mammals....4-35
4.4.7 SEA TURTLES 4-36
4.4.7.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts 4-36
4.4.7.2 Impacts of Other Actions 4-36
4.4.7.3 Maritime Traffic and Vessel Strikes 4-37
4.4.7.4 Ocean Noise 4-37
4.4.7.5 Ocean Pollution....4-37
4.4.7.6 Commercial Fishing....4-37
4.4.7.7 Coastal Development....4-38
4.4.7.8 Cumulative Impacts on Sea Turtles 4-38
4.4.8 BIRDS 4-39
4.4.8.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts 4-39
4.4.8.2 Impacts of Other Actions 4-39
4.4.8.3 Cumulative Impacts on Birds 4-41
4.4.9 MARINE VEGETATION 4-42
4.4.10 MARINE INVERTEBRATES 4-42
4.4.11 FISH 4-43
4.4.11.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts 4-43
4.4.11.2 Impacts of Other Actions 4-43
4.4.11.3 Coastal Development....4-45
4.4.11.4 Cumulative Impacts on Fish....4-45
4.4.12 CULTURAL RESOURCES 4-46
4.4.12.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts 4-46
4.4.12.2 Impacts of Other Actions 4-46
4.4.12.3 Cumulative Impacts on Cultural Resources 4-47
4.4.13 NATIVE AMERICAN AND ALASKA NATIVE TRADITIONAL RESOURCES 4-47
4.4.14 SOCIOECONOMICS....4-47
4.4.15 PUBLIC HEALTH AND SAFETY 4-47
4.5 SUMMARY OF CUMULATIVE IMPACTS 4-47

LIST OF TABLES

TABLE 4.3-1: OTHER ACTIONS AND OTHER ENVIRONMENTAL CONSIDERATIONS IDENTIFIED FOR THE CUMULATIVE IMPACTS ANALYSIS 4-5
TABLE 4.4-1: COMPARISON OF SHIP AND AIRCRAFT GREENHOUSE GAS EMISSIONS TO UNITED STATES 2010 GREENHOUSE GAS EMISSIONS 4-30

LIST OF FIGURES

There are no figures in this section.

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4 CUMULATIVE IMPACTS

4.1 INTRODUCTION

The analysis of cumulative impacts (or cumulative effects)[1] presented in this section follows the requirements of the National Environmental Policy Act (NEPA) and Council on Environmental Quality guidance (Council on Environmental Quality 1997). The Council on Environmental Quality regulations (40 Code of Federal Regulations [C.F.R.] §§ 1500-1508) provide the implementing regulations for NEPA. The regulations define cumulative impacts as:

> "…the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 C.F.R. § 1508.7)."

While a single project may have minor impacts, overall impacts may be collectively significant when the project is considered together with other projects on a regional scale. A cumulative impact is the additive effect of all actions in the geographic area. The Council on Environmental Quality provides guidance on cumulative impact analysis in *Considering Cumulative Impacts under the National Environmental Policy Act* (Council on Environmental Quality 1997). This guidance further identifies cumulative impacts as those environmental impacts resulting "from spatial and temporal crowding of environmental perturbations. The impacts of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the impacts of the first perturbation." This guidance observes that "no universally accepted framework for cumulative impacts analysis exists…" while noting that certain general principles have gained acceptance. The Council on Environmental Quality provides guidance on the extent to which agencies of the federal government are required to analyze the environmental impacts of past actions when they describe the cumulative environmental effect of an action. This guidance provides that an analysis of cumulative impacts might encompass geographic boundaries beyond the immediate area of an action and a timeframe that includes past actions and foreseeable future actions. Thus, the Council on Environmental Quality guidelines observe, "[it] is not practical to analyze cumulative impacts of an action on the universe; the list of environmental impacts must focus on those that are truly meaningful."

4.2 APPROACH TO ANALYSIS

4.2.1 OVERVIEW

Cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the No Action Alternative, Alternative 1, and Alternative 2 (the alternatives) in combination with past, present, and reasonably foreseeable future actions. The cumulative impacts analysis included the following steps, described in more detail below:

1. Identify appropriate level of analysis for each resource.
2. Define the geographic boundaries and timeframe for the cumulative impacts analysis.
3. Describe current resource conditions and trends.

[1] Council on Environmental Quality regulations provide that the terms "cumulative effects" and "cumulative impacts" are synonymous (40 C.F.R. § 1508.8[b]); the terms are used interchangeably by various sources, but the term "cumulative impacts" will be used in this document except for quotations, for continuity.

4. Identify potential impacts of each alternative that might contribute to cumulative impacts.
5. Identify past, present, and other reasonably foreseeable future actions that affect each resource.
6. Analyze potential cumulative impacts.

4.2.2 Identify Appropriate Level of Analysis for Each Resource

In accordance with guidance set forth by the Council on Environmental Quality, the cumulative impacts analysis focused on impacts that are "truly meaningful" (Council on Environmental Quality 1997). The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The rationale for the level of analysis applied to each resource is described in Section 4.4 (Resource-Specific Cumulative Impacts).

4.2.3 Define the Geographic Boundaries and Timeframe for Analysis

The geographic boundaries for the cumulative impacts analysis include the entire Northwest Training and Testing (NWTT) Study Area (Study Area) (see Figure 2.1-1). The geographic boundaries for cumulative impacts analysis for marine mammals and sea turtles were expanded to include activities outside the Study Area that might impact migratory marine mammals and sea turtles. Primary considerations from outside the Study Area include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

Determining the timeframe for the cumulative impacts analysis requires estimating the length of time the impacts of the Proposed Action would last and considering the specific resource in terms of its history of degradation (Council on Environmental Quality 1997). The Proposed Action includes ongoing and anticipated future training and testing activities. While United States (U.S.) Department of the Navy (Navy) training and testing requirements change over time in response to world events and several other factors, the general types of activities addressed by this Environmental Impact Statement (EIS)/Overseas EIS (OEIS) are expected to continue indefinitely, and the associated impacts would occur indefinitely. Likewise, some reasonably foreseeable future actions and other environmental considerations addressed in the cumulative impacts analysis are expected to continue indefinitely (e.g., gravel production, maritime traffic, commercial fishing). Therefore, the cumulative impacts analysis is not bounded by a specific future timeframe. For past actions, the cumulative impacts analysis only considers those actions or activities that have ongoing impacts.

While the cumulative impacts analysis is not limited by a specific timeframe, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative impacts for the indefinite future. Navy environmental planning and compliance for training and testing activities is an ongoing process. The Navy intends to submit applications to the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act (MMPA) authorizations supported by this EIS/OEIS. The anticipated effective dates for these MMPA authorizations would be a 5-year period from October 2015 through October 2020. If the Navy intends to conduct similar testing and training activities beyond October 2020 and impacts to marine mammals are anticipated, the Navy would need to seek a new MMPA authorization for training and testing activities beyond October 2020. Similarly, and in accordance with 40 C.F.R. § 1502.9, if the Navy makes substantial changes in the preferred alternative or there are significant new circumstances or information that are relevant to environmental concerns, the Navy must supplement the Final Environmental Impact Statement. Future environmental planning documents will include cumulative impacts analysis based on information available at that time.

4.2.4 Describe Current Resource Conditions and Trends

Chapter 3 (Affected Environment and Environmental Consequences) describes current resource conditions and trends, and they discuss how past and present human activities influence each resource. The aggregate impacts of past and present actions are reflected in the baseline information presented in Chapter 3 (Affected Environment and Environmental Consequences). This information is used in the cumulative impacts analysis to understand how past and present actions are currently impacting each resource and to provide the context for the cumulative impacts analysis.

4.2.5 Identify Potential Impacts of The Alternatives That Might Contribute to Cumulative Impacts

Direct and indirect impacts of the alternatives, presented in Chapter 3 (Affected Environment and Environmental Consequences), were reviewed to identify impacts relevant to the cumulative impacts analysis. Key factors considered included the current status and sensitivity of the resource and the intensity, duration, and spatial extent of the impacts for each stressor. In general, long-term rather than short-term impacts and widespread rather than localized impacts were considered more likely to contribute to cumulative impacts. For example, for biological resources, population-level impacts were considered more likely to contribute to cumulative impacts than were individual-level impacts. Negligible impacts were not considered further in the cumulative impacts analysis. For marine mammals, any stressor that is expected to result in Level A harassment or Level B harassment, as defined by MMPA, was considered in the cumulative impacts analysis. For Endangered Species Act (ESA)-listed species, any stressor that may affect and is likely to adversely affect the species was considered in the cumulative impacts analysis. Stressors that were determined by the Navy to have no effect or that may affect but are not likely to adversely affect ESA-listed species were not analyzed in detail in the cumulative impacts analysis.

4.2.6 Identify Other Actions and Other Environmental Considerations That Affect Each Resource

A list of other actions was compiled for the Study Area and surrounding areas based on information obtained during the scoping process (Appendix E, Public Participation), communications with other agencies, a review of other military activities, literature review, previous NEPA analyses for actions not included in this document, and other available information. Identified future actions were reviewed to determine if they should be considered further in the cumulative impacts analysis. Factors considered when identifying other actions to be included in the cumulative impacts analysis included the following:

- Whether the other action is reasonably foreseeable, rather than merely possible or speculative
- The timing and location of the other action in relation to proposed training and testing activities
- Whether the other action and each alternative would affect the same resources
- The current conditions, trends, and vulnerability of resources affected by the other action
- The duration and intensity of the impacts of the other action
- Whether the impacts have been truly meaningful, historically significant, or identified previously as a cumulative impact concern

In addition to identifying reasonably foreseeable future actions, other environmental considerations for the cumulative impacts analysis were identified and described. These other considerations include major stressors or issues (e.g., ocean pollution, ocean noise, coastal development, etc.) that tend to be widespread and arise from routine human activities and multiple past, present, and future actions.

Including these other environmental considerations allows an analysis of the current aggregate impacts of past and present actions, as well as reasonably foreseeable actions.

4.2.7 Analyze Potential Cumulative Impacts

The impacts of past and present actions and the anticipated impacts of reasonably foreseeable future actions were characterized and summarized. The incremental impacts of each alternative were then added to the combined impacts of all other actions to describe the cumulative impacts that would result if the No Action Alternative, Alternative 1, or Alternative 2 were implemented. The cumulative impacts analysis considered additive, synergistic, and antagonistic impacts. A qualitative analysis was conducted in most cases based on the available information. The analysis in Chapter 3 (Affected Environment and Environmental Consequences) indicates that the direct and indirect impacts of the No Action Alternative, Alternative 1, and Alternative 2 would be similar for many of the stressors. Therefore, much of the cumulative impacts discussion applies to all three alternatives. Specific differences between the alternatives are discussed when appropriate.

4.3 Other Actions Analyzed in the Cumulative Impacts Analysis

4.3.1 Overview

Table 4.3-1 lists the other actions and other environmental considerations identified for the cumulative impacts analysis. Descriptions of each action and environmental consideration carried forward for analysis are provided in the following sections. The Keyport and Northwest Training Range Complex activities and analysis are incorporated into the NWTT proposed action and analysis. Thus, the Keyport and Northwest Training Range Complex are not considered or analyzed as cumulative impacts.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Offshore Power Generation					
1	Marine Hydrokinetic Projects	Federal Energy Regulatory Commission	Admiralty Inlet, Puget Sound	Present and future	Retained
Restoration, Research, and Conservation Projects and Programs					
2	The Crescent Harbor Salt Marsh and Salmon Restoration Project	U.S. Department of the Navy	Crescent Harbor Marsh on Whidbey Island in Puget Sound	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
3	Maylor Beach Restoration Program	U.S. Department of the Navy	Crescent Harbor and Maylor Beach	Past, present, and future	Dismissed because of negligible to minor impacts on resources in the area affected by this activity and the Proposed Action
4	Hood Canal Dissolved Oxygen Program	Partnership of 28 Organizations (local, state, federal, and tribal government)	Hood Canal	Past, present, and future	Dismissed because this is a program and not a specific action
5	Deep Sea Corals Study	National Center for Coastal Ocean Science	Olympic Coast National Marine Sanctuary	Past, present, and future	Dismissed because this is a study which does not have any associated actions
6	Washington Islands National Wildlife Refuge Comprehensive Conservation Plan	U.S. Fish and Wildlife Service	Flattery Rocks National Wildlife Refuge, Quillayute Needles National Wildlife Refuge, Copalis National Wildlife Refuge	Past	Dismissed because the actions associated with this plan will not affect resources affected by the Proposed Action
7	Olympic Coast National Marine Sanctuary Management Plan Update	Olympic Coast National Marine Sanctuary	Olympic Coast National marine Sanctuary	Past	Retained
8	Surveillance Towed Array Sensor System Low Frequency Active Sonar	U.S. Department of the Navy	Pacific-Indian Ocean	Past, present, and future	Retained
9	U.S. Coast Guard Training	U.S. Coast Guard	Washington, Oregon, and California	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Military Activities					
10	Oregon Air National Guard Flight Training	Oregon Air National Guard	Offshore Area (W-93, W-570)	Past, present, and future	Retained
11	Pile Repair and Replacement Program	U.S. Department of the Navy	Inland Waters (various locations in Puget Sound)	Past, present, and future	Retained
12	NAVBASE Kitsap Bangor, Indian Island, Whidbey, Everett, and Bremerton Waterfront Facilities Maintenance	U.S. Department of the Navy	Bangor, Indian Island, Whidbey, Everett, and Bremerton waterfront	Past, present, and future	Dismissed. Maintenance of facilities includes pressure washing of piers, and repair and replacement of structures as needed; however, measures that would cause cumulative impacts are not projected.
13	Force Protection and Weapons Security Measures	U.S. Department of the Navy	Waterfront Restricted Area of NAVBASE Kitsap Bangor and other Navy waterfront facilities	Past, present, and future	Retained
14	Barge Mooring Project Environmental Assessment/Incidental Harassment Authorization	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present and future	Retained
15	Underwater Surveillance System	U.S. Department of the Navy	Restricted Area at NAVBASE Kitsap Bangor	Past, present, and future	Dismissed. The system operates at the same frequency and range (generally 50–200 kHz—similar to FA3 bin from Table 3.0-8) as a commercial “fish finder” and has been in operation since April 2006. Therefore, impacts should be negligible.
16	Waterfront Restricted Area Land-Water Interface, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Military Activities (continued)					
17	Waterfront Restricted Area Service Pier Extension, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present and future	Retained
18	Explosives Handling Wharf 2, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present, and future	Retained
19	Tribal Mitigation for Explosive Handling Wharf 2	U.S. Department of the Navy	Hood Canal and Gamble Bay	Present and Future	Retained
20	Explosives Handling Wharf 1 Maintenance	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Past, present, and future	Retained
21	NAVBASE Kitsap Bangor Test Pile Program	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Past	Dismissed because the duration of this project spanned only a month, and pile programs at Kitsap Bangor are discussed in the analysis of the Explosives Handling Wharf 1 Maintenance (Section 4.3.4.10).
22	Electromagnetic Measurement Ranging System Project	U.S. Department of the Navy	Hood Canal	Future	Retained
23	Breakwater Construction and Pier Demolition at Naval Air Station Whidbey Island	U.S. Department of the Navy	Crescent Harbor	Future	Retained
24	Swimmer Interdiction Security System EIS, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor	Present, and future	Retained
25	Transit Protection System Facilities, NAVBASE Kitsap Bangor	U.S. Department of the Navy	NAVBASE Kitsap Bangor, Magnetic Silencing Facility; Port Angeles	Present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Military Activities (continued)					
26	P-8A Multi-Mission Aircraft (MMA) Supplemental EIS	U.S. Department of the Navy	Naval Air Station Whidbey Island	Present and future	Retained. However, their training is covered in the proposed action of this EIS/OEIS, and other activities are not in the Study Area (e.g., take offs and landings at Ault Field).
27	EA-18G Growler Environmental Assessment	U.S. Department of the Navy	Naval Air Station Whidbey Island	Present and future	Retained. However, their training is covered in the proposed action of this EIS/OEIS, and other activities are not in the Study Area (e.g., take offs and landings at Ault Field).
28	VAQ Expeditionary Wing Environmental Assessment	U.S. Department of the Navy	Naval Air Station Whidbey Island	Past, present, and future	Dismissed because their training is covered in the proposed action of this EIS/OEIS, and other activities are not in the Study Area (e.g., take offs and landings at Ault Field).
29	U.S. Navy Climate Change Roadmap	U.S. Department of the Navy	All of Study Area	Present and future	Retained
Environmental Regulations and Planning					
30	Coastal and Marine Spatial Planning	Regional Ocean Commissions	All of Study Area	Future	Dismissed because action involves only planning and policy-related activities (discussed in Chapter 6, Additional Regulatory Considerations).
31	Marine Mammal Protection Act incidental take authorizations	National Marine Fisheries Service	All of Study Area	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Environmental Considerations					
32	Fred Hill Materials Thorndyke Resource (pit-to-pier) Project	Fred Hill Materials	West shore of Hood Canal, to south of the Highway 104 Hood canal Bridge	Present and future	Retained
33	Hood Canal In Lieu Fee Mitigation Program	Hood Canal Coordinating council	Hood Canal	Past, present, and future	Retained
34	Jefferson County Black Point Master Planned Resort	Statesman Group of Companies, LTD, and Black Point Properties, LLC	Black Point, Brinnon, and Navy Range Dabob Bay	Present and future	Dismissed because construction takes place on land and there are no plans for in-water construction in the marina, as current slips will be retained. Therefore, this activity should not have a significant impact on resources in the study area.
35	Trans-Pacific fiber optic cable	Pacific Crossing Ltd.	Olympic Coast National Marine Sanctuary/Whidbey Island	Past, present, and future	Dismissed. The trans-Pacific fiber optic cable was laid in 1999–2000 and re-buried in 2005 to comply with existing permits and mitigation. Therefore, the cable's existence in the Study Area should not have a significant impact on resources.
36	Commercial and Recreational Fishing	National Marine Fisheries Service and private industry	All of Study Area and open ocean areas	Past, present, and future	Retained
37	Maritime Traffic	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
38	Shoreline Development	Local regulatory agencies	Inland Areas, Puget Sound	Past, present, and future	Retained
39	Oceanographic Research	Numerous	All of Study Area and open ocean areas	Past, present, and future	Retained
40	Ocean Noise	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (continued)

#	Name of Action	Lead Agency or Proponent	Location in the Study Area	Timeframe	Retained for Further Analysis?
Other Environmental Considerations (continued)					
41	Ocean Pollution	U.S. Environmental Protection Agency Applicable State Agencies	All of Study Area and open ocean areas	Past, present, and future	Retained
42	Washington State Department of Transportation Manette Bridge Replacement Project	Washington State Department of Transportation	Bremerton, Olympic Peninsula, Washington	Past	Dismissed, as the Bridge Replacement Project was completed in February 2012, and there are no present or future impacts to contribute to the cumulative impacts in the analysis.
43	Washington State Department of Transportation Hood Canal Bridge West-Half Retrofit and East-Half Replacement Project	Washington State Department of Transportation	Between Kitsap and Jefferson counties at the mouth of the Hood Canal	Past	Dismissed, as the Bridge Retrofit and Replacement Project was completed in June 2009 and there are no present or future impacts to contribute to the cumulative impacts in the analysis.
44	Marine Tourism and Recreation	Numerous	All of Study Area	Past, present, and future	Retained
45	Commercial and General Aviation	Not applicable	All of Study Area and open ocean areas	Past, present, and future	Retained
46	2013 Bremerton Ferry Terminal Construction by the Washington State Department of Transportation	Washington State Department of Transportation	Bremerton ferry terminal	Future	Retained

Notes: EIS = Environmental Impact Statement, kHz = kilohertz, NAVBASE = Naval Base, NAVSEA = Naval Sea Systems Command, NUWC = Naval Undersea Warfare Center, NWTRC = Northwest Training Range Complex, OEIS = Overseas EIS, U.S. = United States, W = Warning Area

4.3.2 Offshore Power Generation

4.3.2.1 Marine Hydrokinetic Projects

Emerging water power technologies offer the potential to capture energy from waves, thermal gradients, tides, and ocean currents. Once developed, these new technologies will offer alternatives to fossil fuels. At the present time, there is significant research dedicated to the performance and economic viability of hydropower technologies. Because no fully developed marine hydrokinetic projects exist in the North American region, the impact on marine species and ecosystems in the region remains largely speculative. Concerns raised include the potential for collisions, noise, physical disturbance, disruption of marine species' behavioral patterns, impacts on local community and fishing industry, ability to monitor projects, cumulative impacts of multiple hydrokinetic projects along the coasts, habitat alteration due to anchors and cables, and release of toxins and chemicals by the projects or by vessels servicing the project. Other considerations include habitat disturbance and the displacement of benthic organisms. These concerns provide the potential for habitat loss and changes to the ecology of a region (Pacific Fishery Management Council 2011); however, initial studies have indicated that, with appropriate protocols for siting and design, these impacts are likely to be minimal (Union of Concerned Scientists 2008).

As of June 2011, the Federal Energy Regulatory Commission has issued 70 preliminary permits for hydrokinetic projects and 147 preliminary permits are pending. In west coast waters, 22 projects are currently being considered (Pacific Fishery Management Council 2011).

The Puget Sound Pilot Tidal Energy Project (TRL 7/8) is headed up by Snohomish County Public Utility District and its partners, such as the University of Washington. They propose to deploy two tidal energy turbines in Admiralty Inlet, Puget Sound, Washington. The site is one of the largest tidal hydrokinetic resources in the United States, and requires deep water technology (> 164 feet [ft.] [> 50 meters {m}]). The purpose of the project is to gather data to advance the technical, economic, social, and environmental viability of commercial-scale tidal energy. According to a tentative schedule, the turbine and foundation fabrication shipping and staging should be done in 2013, while the project installation and commissioning would occur by 2014, followed by project operations and testing through 2018 (Polagye 2011). Recently, the Japanese Company Pacific Crossing has voiced concerns about the project with the Federal Energy Regulatory Commission (Federal Energy Regulatory Commission 2011). Pacific Crossing owns a fiber optic cable that passes approximately 328 ft. (100 m) away from the proposed installation area near Whidbey Island, and says that the turbines are being installed too close to the cable, which would make maintenance difficult to achieve with the presence of turbines. In January 2013, a Draft Environmental Assessment (EA) was released and found that placing the two turbines in Admiralty Inlet would not harm the environment or nearby fiber optic cables. Pacific Crossing Company disagrees and plans to challenge the report's findings. There are also concerns about the effects on killer whales and native plants. Snohomish County Public Utility District is now planning to have the turbines installed by mid-2014 (Pacific Fishery Management Council 2013).

4.3.3 Restoration, Research, and Conservation Projects and Programs

4.3.3.1 Olympic Coast National Marine Sanctuary Management Plan Update

The Olympic Coast National Marine Sanctuary Management Plan was updated in 2011. This update to the Sanctuary's management plan is dismissed from further cumulative analysis because the update did not alter regulations to Navy actions within the Sanctuary. The Management Plan Update also does not contribute to the overall cumulative impact of activities on marine resources in the Study Area, and

therefore results in negligible to minor impacts on resources in the area affected by the activity and the Proposed Action. The Management Plan update is discussed further in Section 6.1.2.1.1.

4.3.4 OTHER MILITARY ACTIVITIES

4.3.4.1 Surveillance Towed Array Sensor System Low Frequency Active Sonar

In August 2011, the Navy released a Draft Supplemental EIS/Supplemental OEIS that evaluated the potential environmental impacts of employing the Surveillance Towed Array Sensor System Low Frequency Active Sonar (U.S. Department of the Navy 2011). The Navy currently plans to operate up to four Surveillance Towed Array Sensor System Low Frequency Active Sonar systems for routine training, testing, and military operations. Based on current Navy national security and operational requirements, routine training, testing, and military operations using these sonar systems could occur in the Pacific Ocean (including the Study Area).

4.3.4.2 United States Coast Guard

The U.S. Coast Guard (USCG) conducts training throughout the Study Area. In California, District 11 conducts search and rescue, homeland security, law enforcement, marine safety, and aids to navigation missions over 3.3 million square miles (mi.^{2}) of water. The District 13 Coast Guard unit is located in the Pacific Northwest along the coasts of Oregon and Washington. District 13 conducts the same operational duties as the units in District 11 and covers more than 460,000 mi.^{2} of the Pacific Ocean.

U.S. Coast Guard training includes small- and medium-caliber weapons firing from ships, similar to the Navy's Gunnery Exercise (Surface-to-Surface) Ship. The USCG conducts much of this training in the Offshore Area of the Study Area, primarily in Warning Area 237 (W-237). None of the USCG's weapons firing occurs in the Olympic Coast National Marine Sanctuary. These gunnery exercises, which are described in Chapter 2 (Description of Proposed Action and Alternatives), are analyzed in this EIS/OEIS for direct impacts (not cumulative impacts). Those USCG activities analyzed only for their cumulative impact include:

- Flight training in W-237. This flight training includes low-altitude helicopter flights but does not include expenditure of munitions or any other materials.
- Shipboard aircraft operations, such as deck landing qualification training.
- Shipboard maneuvering and engineering training (e.g., abandon ship, anchoring, full power trials, man overboard, and flooding).
- Search and rescue training.

4.3.4.3 Oregon Air National Guard Flight Training

The Oregon Air National Guard is the primary user of W-93 and W-570 special use airspace in the Offshore Area. Oregon Air National Guard flights in W-93 and W-570 are primarily air combat maneuver training flights, similar to those conducted by the Navy and described in Chapter 2 (Description of Proposed Action and Alternatives). These flights occur throughout the year but do not include any weapons firing or release of chaff. On rare occasions, self-defense flares may be used during training.

4.3.4.4 Pile Repair and Replacement Program

The Navy proposes to repair or replace up to 1,001 structurally unsound piles at various Puget Sound installations over a 5-year period, beginning in October 2013. Various piers, wharves, and other marine pile-supported structures are located at the installations. The potential environmental impacts of this action are analyzed in EAs, such as the EA for the Breakwater Construction and Pier Demolition at Naval

Air Station Whidbey Island (U.S. Department of the Navy 2013). The Proposed Action involves pile removal, pile installation, pile disposal, and in-place pile repair, and includes individual actions currently planned and estimates for contingency requirements at Naval Air Station Whidbey Island (NASWI), NAVSTA Everett, Naval Base (NAVBASE) Kitsap Bangor, NAVBASE Kitsap Bremerton, NAVBASE Kitsap Keyport, NAVBASE Kitsap Manchester, and Zelatched Point.

4.3.4.5 Force Protection and Weapons Security Measures

The Force Protection and Weapons Security Measures project involves installation and operation of facilities, including 14 ft. (4.3 m) high above-water fencing on pontoons along the Waterfront Restricted Area. It also involves the construction of an Auxiliary Reaction Force Facility (14,000 square feet [ft.^{2}] [1,300 square meters {m^2}]) and an Armored Fighting Vehicle Operational Storage Facility (16,146 ft.^{2} [1,500 m^2]). It also includes the alteration of two buildings for a new armory (2,500 ft.^{2} [232 m^2]) and the replacement of an Alert Force Garage (2,530 ft.^{2} [235 m^2]) that includes a new paved access road (U.S. Department of the Navy 2012a).

4.3.4.6 Barge Mooring Project Environmental Assessment/Incidental Harassment Authorization

The Navy proposes to replace an existing research barge at the Service Pier in order to support the mission and operations of Commander, Submarine Development Squadron Five, at NAVBASE Kitsap Bangor. The action includes vibratory installation of up to 20 hollow steel piles that range in diameter from 18 inches (in.) (46 centimeters [cm] to 48 in. (122 cm). The 36 in. (91 cm) diameter and 48 in. (122 cm) diameter piles will be used to moor the new 260 ft. (79 m) by 85 ft. (26 m) barge, which is replacing a 115 ft. (35 m) by 35 ft. (11 m) barge that is currently located at the Service Pier. To allow space for the larger barge, the existing floating pier sections used by Port Operations will be relocated to the opposite side of the Service Pier trestle. Additional floating sections will be attached and supported by 18 in. (46 cm) and 24 in. (61 cm) diameter steel piles. Existing infrastructure that is not needed to support the new Service Pier configuration will be removed. The infrastructure includes a gangway, fenders, pedestals, and a mooring dolphin. The mooring dolphin has a concrete platform supported by eight 24–30 in. (61–76 cm) diameter steel piles. The platform will be carefully cut into sections and removed. One 24 in. (61 cm) steel pile will be removed using vibratory pile driving equipment. The remaining piles will be cut off at the mudline and extracted. The duration of the in-water construction activities is expected to be 8 weeks and will occur between 16 July and 30 September 2013 (U.S. Department of the Navy 2012b).

4.3.4.7 Waterfront Restricted Area Land-Water Interface, Naval Base Kitsap Bangor

The Navy proposes to construct two land-water interface structures and modify the existing floating port security barrier system for improved protection of TRIDENT submarines. Construction of the land-water interface structures would enclose the Navy waterfront restricted area on NAVBASE Kitsap Bangor by constructing security barriers in the intertidal zone at the Bangor waterfront. Construction is anticipated to take 2 years. Construction activities occurring in the water during the first year may involve pile driving and would be conducted from July 2015 through February 2016. Once the pile driving is complete, activities other than pile driving may occur in the water up until February 2017.

4.3.4.8 Waterfront Restricted Area Service Pier Extension, Naval Base Kitsap Bangor

The Navy proposes to extend the existing service pier, construct associated support facilities, and relocate two SEAWOLF Class submarines from NAVBASE Kitsap Bremerton to join a third SEAWOLF Class submarine at NAVBASE Kitsap Bangor. The existing service pier would be extended; land-based associated support facilities would be constructed, including a maintenance support facility; and utility

upgrades would include an emergency power generator and a parking lot. Shore-based facilities constructed on the pier would include a pier services and compressor building and a pier crane. Construction would occur from April 2015 to March 2017. Construction in the water is planned for July through February of each year, beginning in July 2015 and concluding in February 2017. The relocation would result in the consolidation of berthing and support for the SEAWOLF Class submarines at NAVBASE Kitsap Bangor.

4.3.4.9 Explosives Handling Wharf 1 Maintenance

The Navy is continuing a construction project to conduct necessary repairs and maintenance on the Explosive Handling Wharf 1 (EHW-1) facility. This multiyear project involves removal and replacement of deteriorated steel and/or concrete piles. The most recent phase, which began in July 2011 and will continue through 2013, is the installation of twenty-nine, 30 in. (76 cm) steel piles, and is covered in two findings of no significant impact (2011 and 2012), the Final Environmental Assessment Explosives Handling Wharf 1 Pile Replacement Project Naval Base Kitsap at Bangor Silverdale, WA, and two incidental harassment authorizations (2011 and 2012). Past activities were covered by Categorical Exclusions as actions did not individually or cumulatively have a significant effect on the human environment. Phased repair of this structure is expected to continue until 2024 (U.S. Department of the Navy 2012a). The wharf is a U-shaped concrete structure built in 1977 for ordnance handling operations in support of the TRIDENT Submarine squadron, which is home ported at the NAVBASE Kitsap Bangor. The EHW-1's structural integrity is compromised due to deterioration of the wharf's piling sub-structure. The purpose of the project is to maintain the structural integrity of the wharf and ensure its continued functionality to support the operational requirements of the TRIDENT program (U.S. Department of the Navy 2012a).

4.3.4.10 Electromagnetic Measurement Ranging System, Hood Canal

An EA is being prepared for the construction and operation of an Electromagnetic Measurement Ranging System located on NAVBASE Kitsap Bangor lands and adjacent waters in Hood Canal (Hood Canal Military Operating Area North) Bangor, Washington.

Construction would occur between July and October 2014. Project construction includes construction of a 15 ft. by 15 ft. (4.5 m by 4.5 m) offshore platform with utilities, requiring installation of five 24 in. (61 cm) square batter precast concrete piles (one for each corner and one in the center of the platform). The five piles would be impact driven. The project also includes installation of the sensor array system and approximately 8,000 ft. (2,438 m) of cable on the bottom of Hood Canal.

4.3.4.11 Breakwater Construction and Pier Demolition at Naval Air Station Whidbey Island

The Navy proposes to construct a new pile-supported breakwater; demolish an existing 536 ft. (163 m) long by 50 ft. (15 m) wide finger pier breakwater; install a fuel pier sheet pile cut-off wall at the existing fuel pier; install new anchor buoys; and dredge a 3.9-acre (ac.) (1.6-hectare [ha]) access channel at NASWI's Seaplane Base at Whidbey Island, Washington. The Proposed Action would take place within Crescent Harbor. The new breakwater would replace the existing structurally unsound finger pier breakwater to ensure continued safe and uninterrupted jet fuel delivery for NASWI. Dredging would improve access to the fuel pier during low tides, reduce the frequency of future maintenance dredging, and enable fuel pier access for vessels with drafts of up to 16 ft. (5 m) (U.S. Department of the Navy 2012c). The Navy is applying for Incidental Harassment Authorization under the MMPA of 1972, as amended. The proposed in-water work would occur between 16 July 2014 and 15 February 2015 (U.S. Department of the Navy 2012d).

4.3.4.12 Swimmer Interdiction Security System, Naval Base Kitsap Bangor

The Navy implemented a Swimmer Interdiction Security System at NAVBASE Kitsap Bangor, Silverdale, WA, after an EIS written in 2009 followed by the Record of Decision (74 Federal Register [FR] 60244) in November 2009, in order to meet the increased U.S. security requirements for military installations in response to the terrorist attacks of September 11, 2001. The Marine Mammal Alternative (the preferred alternative) is composed of human/marine mammal teams that support Navy operations and respond rapidly to security alerts. The Swimmer Interdiction Security System protects waterside Navy assets and will remain in operation as long as valuable naval assets are at NAVBASE Kitsap Bangor (U.S. Department of the Navy 2009).

4.3.4.13 Explosives Handling Wharf 2, Naval Base Kitsap Bangor

The Navy is building and will operate a second Explosives Handling Wharf (EHW-2) immediately south of the existing EHW at NAVBASE Kitsap Bangor. EHW-2 will be a large pile-supported structure to support TRIDENT submarines homeported at Bangor. The in-water facility will cover 6.3 ac. (2.5 ha), and will be supported by up to 1,250 hollow steel piles. Construction began in fall 2012, and completion is expected in 2016. EHW-2 consists of in-water structures and onshore support facilities including roads, utilities, and security features. Approximately 20 existing facilities and/or structures in proximity of EHW-2 will be modified or demolished, and 4 new on-shore facilities will be constructed. Environmental impacts during construction include: disturbance to fish, bird, and marine mammals from pile driving noise; turbidity; air pollutant emissions; and temporary loss of brush and forest. Long-term impacts include shading of marine habitat, loss of seafloor due to pile placement, interference with migration of juvenile salmon, and loss of upland wetlands. The Navy obtained permits and authorizations for impacts to aquatic habitats, ESA-listed species, and marine mammals. Mitigation measures include purchase of aquatic habitat credits from the Hood Canal In Lieu Fee Program, use of bubble curtains and equipment procedures to reduce species impacts from pile driving noise, marine species monitoring and reporting, revegetation of temporarily disturbed upland areas, public and mariner notification of upcoming construction activities, and specific mitigation actions to compensate for impacts to tribal treaty resources (U.S. Department of the Navy 2012a).

4.3.4.14 Tribal Mitigation for Explosive Handling Wharf 2

The Navy will implement the following mitigation actions in the form of funded programs to compensate for impacts to tribal treaty resources.

4.3.4.14.1 Fishery Improvements

The Navy will provide funding for infrastructure improvements at three existing hatcheries owned and operated by Washington Department of Fish and Wildlife (Hoodsport, McKernan, and George Adams) and one existing fish capture facility owned and operated by the Skokomish Indian Tribe (Enetai Creek) to improve salmon production and associated harvest opportunities in Hood Canal. Improvements to the Washington Department of Fish and Wildlife facilities may include repair or restoration, but will not include recurring annual costs. These projects, funded by the Navy, will help improve the fisheries in the Skokomish tribal facilities, and increase the number of spawned fish available for harvest.

4.3.4.14.2 Shore and Benthic Improvements

Beach Enhancement

The Navy will provide funding for beach enhancements to include substrate improvements and 3 years of shellfish seeding on 24 ac. (9.7 ha) of beach. This action will occur on lands owned by the Skokomish

Tribal Nation that will be transferred to the Department of Interior, Bureau of Indian Affairs to be held in trust for the tribe.

Shellfish Enhancement

The Navy will provide funding for a 5-year program for seeding of shellfish including manila clams, bagged and single Pacific oyster seed, and Olympia oysters on priority shellfish enhancement areas in Hood Canal and adjacent Admiralty Inlet. The Tribes are solely responsible for selecting the beaches to be seeded and coordinating these efforts with the land owners and responsible agencies.

Shellfish Nursery, Floating Upweller System

The Navy will provide funding for construction and operation of a 75 ft. by 30 ft. (23 m by 9 m) Shellfish Nursery, Floating Upweller System, a 30 ft. by 100 ft. (9 m by 31 m) grated work-deck attached to the Port Gamble S'Klallam Tribe's existing net pens in Port Gamble Bay, associated mooring and underwater power supply systems, and four 50 ft. by 50 ft. (15 m by 15 m) steel net pen cages to replace the existing deteriorated cages. The nursery will be capable of accommodating approximately 8–12 million shellfish seed annually. The Port Gamble S'Klallam Foundation or designated entity pursuant to the Memorandum of Agreement will acquire and comply with all required permits, leases, and entitlements as part of this project.

Subtidal Geoduck Enhancement Survey and Study

The Navy will provide funding for geoduck enhancement surveys within the Tribes' usual and accustomed fishing grounds and stations, and for a pilot research study to provide information on new locations for geoduck planting, and to develop sustainable geoduck growing, planting, and other enhancement methodologies. The majority of surveys will occur on tracts having limited survey information. Some surveys will occur on previously harvested tracts. The pilot study will include a literature review and testing of long-term geoduck production processes and enhancement through systematic trials and a comparison of techniques. The Tribes are solely responsible for coordinating survey efforts with land owners.

4.3.4.14.3 Wet Lab Building and Research, Education, and Training

The Navy will provide funding to construct a shellfish wet lab, education, and training building in an upland location at Port Gamble. The research, education, and training program will be developed by the Port Gamble S'Klallam Tribe and will provide education and training for members of the Tribes and the community and research on the health of Hood Canal and marine systems and on shellfish and finfish management. The program may include field training, outreach, shoreline habitat projects, shellfish seed production, and other activities. The wet lab building will be a minimum of 40 ft. by 80 ft. (12 m by 24 m) and will provide a space for facilitating the shellfish seed planting, for equipment storage, and for the Education and Training program, including a small classroom and public meeting space and staff offices.

4.3.4.14.4 Land Conservation

The Navy will provide funding for the acquisition and conservation of lands on the west shore of Port Gamble Bay. The funds for the purchase of lands may be used within two designated blocks of land. The two areas include the 566 ac. (229 ha) shoreline block which includes approximately 26 parcels and the 678 ac. (274 ha) Maritime Forest Block which includes approximately 34 parcels.

4.3.4.15 Transit Protection System Facilities, Naval Base Kitsap Bangor

This project provided berthing for three types of Transit Protection System vessels and various Port Operations tugs and small craft. In addition, the project provided the necessary support facilities ashore for the command, administrative operations, and support functions of the crews and command personnel of associated escort vessels and craft. This project occurred in Fiscal Year (FY) 2011 and involved the demolition of an existing pier and the installation of piles for the new pier. The development involved several potentially significant issues, including impacts to endangered and threatened species, storm water runoff, demolition material disposal, and the avoidance of impacts on valuable upland natural resources.

4.3.4.16 P-8A Multi-Mission Aircraft

The Navy decided in 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron into the U.S. Navy Fleet. The P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion, at existing maritime patrol homebases. The action will result in the homebasing of four fleet squadrons (24 aircraft) at NASWI, Washington. The introduction of the MMA squadrons in the U.S. Navy Fleet is projected to begin no later than 2012 and be completed by 2019 and was analyzed in an EIS (U.S. Department of the Navy 2008). Since the completion of the original EIS, the Navy has prepared a Supplemental EIS to analyze homebasing an additional three squadrons at NASWI, Washington. The change in aircraft stationed at NASWI has been incorporated in the Alternative 1 and 2 activity levels of this NWTT EIS/OEIS.

4.3.4.17 Electronic Attack Squadron Expeditionary Wing Environmental Assessment

The Navy has prepared an EA proposing to transition the Expeditionary Electronic Attack squadrons at NASWI from the aging EA-6B Prowler to the newer EA-18G Growler in the 2012–2014 timeframe (U.S. Department of the Navy 2012e). The action discussed in this EA includes the addition of up to 11 EA-18G aircraft at NASWI. Training for this aircraft is included in the Alternative 1 and 2 numbers in the NWTT EIS/OEIS.

4.3.4.18 United States Department of the Navy Climate Change Roadmap

The Navy Climate Change Roadmap outlines the Navy's approach to observing, predicting, and adapting to climate change by providing a chronological list of Navy-associated action items, objectives, and desired effects for FY 2010–2014. The Navy Climate Change Roadmap focuses on strategy, policy, and plans; operations and training; investments in capability and infrastructure; strategic communications and outreach; and EA and prediction. The Roadmap has five main objectives. The first is that the Navy is fully mission-capable through changing climatic conditions, while actively contributing to national requirements for addressing climate change. The second is that Naval force structure and infrastructure are capable of meeting combatant commander requirements in all probable climatic conditions over the next 30 years. The third is that the Navy understands the timing, severity, and impact of current and projected changes in the global environment. The fourth is that the media, public, government, Joint, interagency, and international community understand how and why the Navy is effectively addressing climate change. Finally, the last objective of the Navy Climate Change Roadmap is for the Navy to be recognized as a valuable joint, interagency, and international partner in responding to climate change (U.S. Department of the Navy 2010).

The roadmap specifies Navy Actions over three phases. Phase 1 was in FY 2010 where Naval War College coursework included climate change impacts on national security, and the requirements of a next

generation operational and climatic environmental prediction capability were defined. Phase 2 was from FY 2011 to 2013 and has four significant actions:

1) Incorporate climate change considerations in strategic guidance documents, such as the Navy Strategic Guidance in support of Program Review 2013 and the Navy Strategic Plan in support of the Navy's Program Objective Memorandum for FY 2014.
2) Develop recommendations to address climate change requirements in Sponsor Program Proposals for the Navy's Program Objective Memorandum for FY 2014.
3) Formalize new cooperative relationships that increase the Navy's capability to assess, predict, and adapt to climate change.
4) Include climate change considerations in fleet training and planning.

The third and final phase will include the execution of the Navy Program Objective Memorandum for FY 2014 budget initiatives that address climate change, and the initiation of intergovernmental, multilateral, and bilateral activities, which increase the Navy's ability to assess, predict, and adapt to climate change. The third and final phase is occurring in FY 2013–2014, and includes the execution of the Navy Program Objective Memorandum FY 2014 budget initiatives that address climate change, as well as the initiation of intergovernmental, multilateral, and bilateral activities that increase the Navy's ability to assess, predict, and adapt to climate change (U.S. Department of the Navy 2010). Every 4 years, the director of Task Force Climate Change will review and revise the roadmap following promulgation of the Quadrennial Defense Review, and will incorporate the review's guidance as appropriate.

4.3.5 Environmental Regulations and Planning

4.3.5.1 Coastal and Marine Spatial Planning

Dismissed because action involves only planning and policy-related activities.

4.3.5.2 Marine Mammal Protection Act Incidental Take Authorizations

The MMPA generally prohibits "takes" of marine mammals in U.S. waters by any person and by U.S. citizens in international waters. The National Oceanic and Atmospheric Administration (NOAA) can authorize "takes" for specific activities (National Oceanic and Atmospheric Administration 2012c). Take authorizations will be issued for the proposed action in the NWTT Study Area, and for other actions occurring inside and outside of the Study Area.

4.3.6 Other Environmental Considerations

4.3.6.1 Fred Hill Materials Thorndyke Resource (Pit-to-Pier) Project

Fred Hill Materials, a materials supply firm based in Poulsbo, constructed a 4-mile (mi.) (6.4-kilometer [km]) conveyor belt connecting a 781 ac. (316 ha) inland gravel mine to 1,100 ft. (335 m) long, 80 ft. (24 m) high pier and 900 ft. (274 m) long moorage dock. The shipping facility is on the west shore of Hood Canal, 5 mi. (8 km) south of the Highway 104 Hood Canal Bridge. When fully operational the "pit to pier" operation would mine, transport, and ship an estimated 60,000 tons (54,432 metric tons) of gravel loading into barges and ships bound for domestic and foreign ports. Operations would be 24 hours a day and each vessel would travel under or through the opening of the floating Hood Canal Bridge. There is considerable uncertainty as to whether this project will be implemented.

4.3.6.2 Hood Canal In Lieu Fee Mitigation Program

The Hood Canal In Lieu Fee Mitigation Program is a voluntary program sponsored by the Hood Canal Coordinating Council, where entities can purchase mitigation credits to offset unavoidable adverse impacts to aquatic resources within the Hood Canal watershed. The primary goal of the Hood Canal Coordinating Council in Lieu Fee Program for Hood Canal is to increase aquatic resource functions in the Hood Canal watershed. The Hood Canal Coordinating Council in Lieu Fee Program is intended to ensure no net loss through the preservation, enhancement, establishment, and restoration of ecological functions within target watersheds through the establishment and management of mitigation sites. The service area for the Hood Canal Coordinating Council In Lieu Fee Program encompasses Hood Canal and those portions of Water Resource Inventory Areas 14, 15, 16, and 17 draining to Hood Canal, defined by a line extending from Foulweather Bluff to Tala Point, south through the Great Bend to its terminus near the town of Belfair, Washington. The service area is divided into two components for the In Lieu Fee Program: Freshwater Environment, which generally includes areas landward of the marine riparian zone including freshwater and estuarine wetlands and streams up to and excluding any National Park or National Forest Lands; and Marine/Nearshore Environment, which extends from the marine riparian area at the top of the coastal bluffs to the adjacent aquatic intertidal and subtidal zones. The mitigation strategy selected for each permitted impact will be based on an assessment of type and degree of disturbance at the landscape and/or drift cell.

4.3.6.3 Commercial and Recreational Fishing

Commercial and recreational fishing constitutes an important and widespread use of the ocean resources throughout the Study Area. Fishing can adversely affect fish populations, other species, and habitats. Potential impacts of fishing include overfishing of targeted species, bycatch, entanglement, and habitat destruction, all of which negatively affect fish stocks and other marine resources. Bycatch is the capture of fish, marine mammals, sea turtles, seabirds, and other nontargeted species that occur incidentally to normal fishing operations. Use of mobile fishing gear such as bottom trawls disturbs the seafloor and reduces habitat structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), habitat destruction, and the generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine animals.

Fishing can also have a profound influence on individual targeted species populations. In a study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer-term data and information, they concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climatic change. Fisheries bycatch has been identified as a primary driver of population declines in several marine species, including sharks, mammals, seabirds, and sea turtles (Wallace et al. 2010). For example, entanglement in nets from the Pacific Northwest coastal salmon fisheries has been shown to increase mortality in seabirds (Hamel et al. 2009). Habitat destruction caused by bottom trawling and other fishing methods also contributes to the negative effects of commercial and recreation fishing on multiple species, such as the North American groundfish (Melnychuk et al. 2013).

4.3.6.4 Maritime Traffic

Portions of the Study Area are heavily traveled by commercial, recreational, and government marine vessels, with several commercial ports occurring in or near the Study Area. Several harbor facilities of interest to the U.S. Navy are located in the Puget Sound: Naval Station Everett; NAVBASE Kitsap Bremerton, NAVBASE Kitsap Bangor, Naval Undersea Warfare Center Keyport, Naval Magazine Indian Island, NASWI, the Port of Seattle, and the Port of Tacoma. Maritime traffic on the Puget Sound is heavy, many large commercial vessels use the Ports of Everett, Seattle, Tacoma, and others in the area, and they enter and depart Puget Sound each day. Additional traffic on the Sound is created by the frequent runs of large Washington State vehicle and passenger ferries as they cross the Sound on generally east-west traffic routes that are perpendicular to normal inbound and outbound maritime traffic channels. Additionally, many recreational and commercial small craft operate throughout the Puget Sound and adjacent waters. The United States has grown increasingly dependent on international trade over the past 50 years. Section 3.12 (Socioeconomic Resources) provides additional information for marine vessel traffic in the Study Area. Primary concerns for the cumulative impacts analysis include vessels striking marine mammals and sea turtles, introduction of non-native species through hull fouling and ballast water, and underwater sound from ships and other vessels.

4.3.6.5 Shoreline Development

Shoreline development adjacent to the Study Area is both intensive and extensive. Development has impacted and continues to impact coastal resources through point and nonpoint source pollution; concentrated recreational use; and intensive ship traffic using major port facilities. The Study Area also includes extensive coastal tourism development (hotels, resorts, restaurants, food industry, residential homes, etc.) and the infrastructure supporting coastal development (retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, recreational fishing facilities, etc.). The focus of this analysis is on shoreline development in Washington because of the close proximity of the Study Area to the shores of Washington. The offshore portion of the Study Area is 12 nm off the coast of Oregon, and California, and therefore shoreline development in that part of the Study Area will have minimal impact on resources in the Study Area.

Coastal development intensifies use of coastal resources, resulting in potential impacts on water quality, marine habitat, and air quality. Coastal development is therefore closely regulated by Washington, Oregon, and California through the Coastal Zone Management Act. New development in the coastal zone requires a permit from the state or local government to which permitting authority has been delegated (Chapter 6, Additional Regulatory Considerations, provides additional information on coastal zone management in each state).

4.3.6.6 Oceanographic Research

There are currently scientific research permits and General Authorizations for research issued by NMFS for cetacean work in the North Pacific. The most invasive research involves tagging or biopsy while the remainder focuses on vessel and aerial surveys and close approach for photo-identification. Species covered by these permits and authorizations include small odontocetes, sperm whales and large mysticetes. One permit issued to the Office of Protected Resources of NMFS allows for responses to strandings and entanglements of listed marine mammals. NMFS has also issued General Authorizations for commercial photography of non-listed marine mammals, provided that the activity does not rise to Level A Harassment of the animals. These authorizations are usually issued for no more than 1 or 2 years, depending on the project.

Three consecutive marine geophysical (seismic) surveys are authorized to be conducted in the Northeast Pacific Ocean, for the time period of June–August 2012. Three Level B harassment incidental take authorizations for marine mammals are issued to the Lamont-Doherty Earth Observatory, a part of Columbia University. The Observatory with research funding from the U.S. National Science Foundation, plans to conduct three research studies on the Juan de Fuca Plate, the Cascadia thrust zone, and the Cascadia subduction margin in waters off the Oregon and Washington coasts. The Observatory will use one source vessel, a seismic airgun array, a single hydrophone streamer, and the ocean bottom seismometers to conduct the seismic surveys. They also intend to operate a multibeam echosounder and a subbottom profiler continuously throughout the surveys (FR 77: 136 2012).

These acoustic stimuli generated during the operation of the seismic airgun arrays may have the potential to cause a short-term behavioral disturbance for marine mammals in the survey area. The surveys should provide data to characterize the evolution and state of hydration of the Juan de Fuca plate at the Cascadia subduction zone, provide information on the buried structures in the region, and assess the location, physical state, fluid budget, and methane systems of the Juan de Fuca plate boundary and overlying crust. The results of the three studies will also provide background information for generating improved earthquake hazards analyses and a better understanding of the processes that control megathrust earthquakes, which are produced by a sudden slip along the boundary between a subducting and an overriding plate (FR 77: 136 2012).

The impacts of this type of research are largely unmeasured. However, given the analysis and scrutiny given to permit applications, it is assumed that any adverse effects are largely transitory (e.g., inadvertent harassment, biopsy effects, etc.). Data to assess population level effects from research are not currently available, and it is uncertain that research effects could be separately identified from other adverse effects on cetacean populations in Pacific Northwest waters.

4.3.6.7 Ocean Noise

Noise is generally described as unwanted sound—sound that clutters and masks other sounds of interest (Richardson et al. 1995). Anthropogenic sources of noise that are most likely to contribute to increases in ocean noise are vessel noise from commercial shipping and general vessel traffic, oceanographic research, oil and gas exploration, underwater construction, and naval and other use of sound navigation and ranging (sonar).

Any potential for cumulative impact should be put into the context of recent changes to ambient sound levels in the world's oceans as a result of anthropogenic activities. However, there is a large and variable natural component to the ambient noise level as a result of events such as earthquakes, rainfall, waves breaking, and lightning hitting the ocean as well as biological noises such as those from snapping shrimp and the vocalizations of marine mammals.

Andrew et al. (2002) compared ocean ambient sound from the 1960s to the 1990s from a receiver approximately 25 mi. (40 km) west of Point Sur, California. The data showed an increase in ambient noise of approximately 10 decibels (dB) in the frequency ranges of 20–80 Hertz (Hz) and 200–300 Hz, and about 3 dB at 100 Hz over a 33-year period. Each 3 dB increase is noticeable to the human ear as a doubling in sound level. A possible explanation for the rise in ambient noise is the increase in shipping noise. There are approximately 11,000 supertankers worldwide, each operating 300 days per year, producing constant broadband noise at source levels of 198 dB (Hildebrand 2004).

Appendix G (Acoustic Primer) provides additional information about sources of anthropogenic sound in the ocean and other background information about underwater noise. This appendix describes the different types of effects that are possible and the potential relationships between sound stimuli and long-term consequences for individual animals and populations. A variety of impacts may result from exposure to sound-producing activities. The severity of these impacts can vary greatly between minor impacts that have no real cost to the animal, to more severe impacts that may have lasting consequences. The major categories of potential impacts are: behavioral reactions, physiological stress, auditory fatigue, auditory masking, and direct trauma.

4.3.6.8 Ocean Pollution

Pollution is the introduction of harmful contaminants that are outside the norm for a given ecosystem. Ocean pollution has and will continue to have serious impacts on marine ecosystem. Common ocean pollutants include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from non-point sources (i.e., storm water runoff from watersheds), point sources (i.e., wastewater treatment plant discharges), other land-based sources (i.e., windblown debris), spills, dumping, vessels, and atmospheric deposition.

4.3.6.8.1 Non-Point Sources, Point Sources, and Atmospheric Deposition

Storm water runoff, wastewater, and nonpoint source pollution, are considered major causes of impairment of ocean waters. Storm water runoff from coastal urban areas and beaches carries waste such as plastics and Styrofoam into coastal waters. Sewer outfalls also are a source of ocean pollution. Sewage can be treated to eliminate potentially harmful releases of contaminants; however, releases of untreated sewage occur due to malfunctions or overloads to the infrastructure, resulting in releases of bacteria usually associated with feces, such as *Escherichia coli* and *Enterococci spp*. Bacteria levels are used routinely to determine the quality of water at recreational beaches and as indicators of the possible presence of other harmful microorganisms. In the past, toxic chemicals have been released into sewer systems. While such dumping has long been forbidden by law, the practice left ocean outflow sites contaminated. Sewage treatment facilities generally do not treat or remove persistent organic pollutants, such as polychlorinated biphenyl (PCB) and dichlorodiphenyltrichloroethane (DDT), or other toxins.

Hypoxia (low dissolved oxygen concentration) is a major impact associated with point and non-point sources of pollution. Hypoxia occurs when waters become overloaded with nutrients from pesticides such as nitrogen and phosphorus, which enter oceans from non-point source runoff, wastewater treatment plants, and atmospheric deposition. Too many nutrients can stimulate algal blooms—the rapid expansion of microscopic algae (phytoplankton). When excess nutrients are consumed, the algae population dies off and the remains are consumed by bacteria. Bacterial consumption causes dissolved oxygen in the water to decline to the point where marine life that depends on oxygen can no longer survive (Boesch et al. 1997).

Almost 200 million tons of criteria pollutants (sulfur dioxide, nitrogen dioxide, carbon monoxide, lead, volatile organic compounds, and particulate matter) were emitted into the United States Atmosphere in 1997 (U.S. Environmental Protection Agency 1998). Through the process of wet and dry atmospheric deposition, these and other pollutants can return to the earth and the waters. Wet deposition removes gases and particles from the atmosphere and deposits them on the surface of the earth through rain, sleet, snow, and fog. While dry deposition is a process through which particles and gases are deposited in the absence of precipitation, such as through dust (U.S. Geological Survey 2000). This atmospheric

deposition also contributes to the buildup of pollutants in the Study Area. Non-point sources, point sources, and atmospheric deposition also contribute toxic pollutants such as metals, pesticides, and other organic compounds to the marine environment. Toxic pollutants may cause lethal or sublethal effects if present in high concentrations, and can build up in tissues over time and suppress immune system function, resulting in disease and death for marine organisms. The main causes of pollution in the Study Area are oil spills, stormwater run-off, dairy farm run-off, hazardous waste sites, combined sewer overflows, and highway stormwater outfalls (Puget Soundkeeper Alliance 2012).

4.3.6.8.2 Marine Debris

Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned in the marine environment. Common types of marine debris include various forms of plastic and abandoned fishing gear, as well as clothing, metal, glass, and other debris. Marine debris degrades marine habitat quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service 2006).

Plastic marine debris is a major concern because it degrades slowly and many plastics float, allowing the debris to be transported by currents throughout the oceans. Currents in the oceanic convergence zone in the North Pacific Subtropical Gyre act to accumulate the floating plastic marine debris. These debris carrying currents include the south-flowing California Current, and the north-flowing Gulf of Alaska Current. These currents distribute debris throughout the Study Area. Debris found in the Puget Sound (inland waters) portion of the Study Area, include pieces of hard plastic, insulation, pre-production plastic pellets, pieces of bags or wrappers, fishing line, rope, or synthetic cloth, cigarette butts and filters, glass fragments and shards, rubber, metal, and “other” unclassified debris (Kingfisher 2011).

Additionally, plastic waste in the ocean chemically attracts hydrocarbon pollutants such as PCB and DDT, which accumulate up to one million times more in plastic than in ocean water (Mato et al. 2001). Fish, marine animals, and birds can mistakenly consume these wastes containing elevated levels of toxins instead of their prey. In the North Pacific Subtropical Gyre it is estimated that the fishes in this area are ingesting 12,000–24,000 U.S. tons (10,886,216–21,772,433 kilograms [kg]) of plastic debris a year (Davison and Asch 2011).

Debris that sinks to the seafloor is also a concern for ingestion and entanglement by fish, invertebrates, sea turtles, marine mammals, and marine vegetation. Sunken debris is also a contributor to marine habitat degradation. Military expended materials will also contribute to the marine debris loading of the seafloor in the Study Area. In the U.S. west coast Groundfish Bottom Trawl Surveys of 2007 and 2008, anthropogenic debris was observed at depths of 55–1,280 m (180.5–4,199.5 ft.). The density of debris increased with depth, and the majority of the debris was plastic and metallic, while the rest of it was fabric and glass (Keller et al. 2010).

4.3.6.9 Marine Tourism

Tourism is Alaska’s second biggest industry in terms of employment, and is the main industry of many small and isolated communities. The coast and some major rivers are the center of Alaska’s tourism. Sport fishing is one of the biggest industries along with the growing number of ecotourists visiting the state. In the summer of 2011 alone, there were a total of 1,556,800 visitors to the state. Cruise ship visitors make up a majority of 57 percent or 883,000 of those visitors. The second most popular activity of tourists in Alaska is wildlife viewing (52 percent), much of which occurs on the coast. Between 2006 and 2011, the percentage of visitors from the United States fell by 2 percent, while Canada and the other International categories each increased by 1 percent.

In 2009, visitors to Washington spent $14.2 billion; although this is a decrease from 2008 it was reflective of national trends at the time. Travel and tourism is Washington's fourth largest export industry which supports jobs, bolsters local economies and small businesses and contributes tax revenue for state and local governments. Seattle itself attracts about 9.9 million visitors annually, which contributes about $463 million in state and local tax revenues. Washington attracts tourists through water trails, the Cascadia Marine Trail, and other ocean tourism ventures that are based on conservation, environmental impact, visitor management, and community relations and education (Labor 1999).

The total overnight trips to the Oregon Coast totaled 9.6 million visitors, which was about 35 percent of the total visitors in 2009. Spending on the coast in 2009 totaled $1.37 billion, with only 10 percent of that total being spent on Recreation and 36 percent on Lodging. Sixty-seven percent of visitors spent their time at the Beach or Waterfront, while 16 percent spent time swimming and 11 percent went fishing (Regional Visitor Research, Oregon 2009). The majority of the tourism industry's employment in Oregon is in accommodation and food services, while 15 percent are in travel and transportation, and the remaining 25 percent is divided between retail trade and arts, entertainment, and recreation. In 2010 there were approximately 161,900 workers in the leisure and hospitality industry, the majority of which were service workers whose wages are low, resulting in a lower average wage. The most recent employment projections forecast that leisure and hospitality will grow about 19 percent from 2010 to 2020. This $2 billion travel and tourism industry plays an important role in Oregon's economy (Jackson-Winegardner 2012).

Between 1990 and 2000, the ocean-related gross state product for California grew by 10.6 percent with one of the largest growth trends experienced in coastal recreation and tourism. California's trend reflects the international trend of coastal tourism and recreation growth which has continued in past decades while other industries have declined. Additionally, the growth is seen in the development of "services" rather than "goods-related" activities (Kildow and Colgan 2005). Stakeholders in tourism services have economical motivation to ensure positive management of marine resources on which their industries are based, therefore the impacts of marine tourism is generally localized and of small magnitude. Rapid expansion of tourism could increase pressure for additional coastal and urban development which would result in potential indirect and cumulative effects on marine resources (Harriott 2002). The Marine Institute found that the issues relating to tourism included visitor pressures on coastal ecology; carrying capacity; information gap (i.e., insufficient data to assess impacts of tourism); anthropogenic impacts (i.e., displacement of seabirds, habitat and roosting opportunities, conflicts with users and wildlife, altering food sources); threats to ecology; development pressure; infrastructural support; user conflicts; and motorized crafts (Connolly et al. 2001).

4.3.6.10 Commercial and General Aviation

Commercial and general aviation are retained for analysis and discussion in Section 4.4.4.1 (Greenhouse Gases).

4.3.6.11 2013 Bremerton Ferry Terminal Construction by the Washington State Department of Transportation

To improve, maintain, and preserve the terminals, Washington State Department of Transportation conducts construction, repair and maintenance activities as part of its regular operations. One of these projects is the replacement of wingwall structures at the Bremerton ferry terminal. The project has submitted an Incidental Harassment Authorization request. The proposed project will occur in marine waters that support several marine mammal species. The project's timing and duration and specific

types of activities (such as pile driving) may result in the incidental taking by acoustical harassment (Level B take) of marine mammals protected under the MMPA. The Washington State Department of Transportation is requesting an Incidental Harassment Authorization for the six marine mammal species (harbor seal, California sea lion, Steller sea lion, killer whale, gray whale, humpback whale) that may occur in the vicinity of the projects. The current timber wingwalls at the Bremerton terminal are near the end of their design life and must be replaced with steel wingwalls to ensure safe and reliable functioning of the terminal (Washington State Ferries 2012).

4.4 Resource-Specific Cumulative Impacts

4.4.1 Resource Areas Dismissed from Cumulative Impacts Analysis

In accordance with Council on Environmental Quality guidance (Council on Environmental Quality 2010), the cumulative impacts analysis focused on impacts that are "truly meaningful." The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The analysis focused on marine mammals, sea turtles, and cultural resources. While each of the following resources is discussed briefly in the following sections, detailed analysis of cumulative impacts on the following resources was not necessary as the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low. Further analysis of cumulative impacts is not warranted on the following resources:

- Sediments and water quality
- Marine habitats
- Marine vegetation
- Marine invertebrates
- Socioeconomic resources
- Public health and safety

4.4.2 Sediments and Water Quality

The analysis in Section 3.1 (Sediments and Water Quality) indicates that the alternatives could result in local, short- and long-term changes in sediment and water quality. However, chemical, physical, or biological changes to sediments or water quality would be below applicable standards, regulations, and guidelines and would be within existing conditions or designated uses (Section 3.1.1.2, Methods, lists applicable standards, regulations, and guidelines). The short-term impacts would arise from explosions and the byproducts of explosions and combusted propellants. It is unlikely these short-term impacts would overlap in time and space with other future actions that produce similar constituents. For example, training and testing with explosives would not be expected to occur near operations like the 2013 Bremerton Ferry Terminal Construction, where explosives are already being used. Therefore, the short-term impacts described in Section 3.1 (Sediments and Water Quality) are not expected to contribute to cumulative impacts.

The long-term impacts would arise from unexploded ordnance, noncombusted propellant, metals, and other materials. Long-term impacts of each alternative would be cumulative with other actions that cause increases in similar constituents. However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to long-term cumulative impacts would be negligible because

- most training and testing activities are widely dispersed in space and time;
- most components of expended materials are inert or corrode slowly;

- numerically, most of the metals expended are small- and medium-caliber projectiles; metals of concern comprise a small portion of the alloys used in expended materials, and metal corrosion is a slow process that allows for dilution;
- most of the components are subject to a variety of physical, chemical, and biological processes that render them benign; and
- potential areas of impacts would be limited to small zones immediately adjacent to the explosive, metals, or chemicals other than explosives.

Furthermore, none of the alternatives would result in long-term and widespread changes in environmental conditions, such as nutrient loading, turbidity, salinity, or pH (a measure of the degree to which a solution is either acidic [pH less than 7.0] or basic [pH greater than 7.0]).

Based on the analysis presented in Section 3.1 (Sediments and Water Quality) and the reasons summarized above, the changes in sediment or water quality would be measurable, but would still be below applicable state, federal, and U.S. Environmental Protection Agency (USEPA) standards and guidelines; therefore the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low and further analysis of cumulative impacts is not warranted.

4.4.3 AIR QUALITY

As detailed in Section 3.2 (Air Quality), increased training and testing activities conducted under Alternatives 1 and 2 would result in increased criteria pollutant emissions and hazardous air pollutant emissions throughout the Study Area. Sources of the increased emissions would include vessels and aircraft, and to a lesser extent munitions. Potential impacts include localized and temporarily elevated pollutant concentrations. Recovery would occur quickly as emissions disperse, and there would be no significant impact on air quality. The impacts of Alternatives 1 or 2 would be cumulative with other actions that involve criteria air pollutant and hazardous air pollutant emissions. However, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low for the following reasons:

- Few stationary offshore air pollutant emission sources exist within the Study Area and few are expected in the foreseeable future.
- International regulations by the International Maritime Organization require commercial shipping vessels to switch to lower-sulfur fuel near U.S. and international coasts beginning in 2012 (National Oceanic and Atmospheric Administration 2011a). The Department of Defense (DoD) has released the Operational Energy Strategy: Implementation Plan which will reduce demand, diversify energy sources, and integrate energy consideration into planning (U.S. Department of Defense 2012). The U.S. Department of the Navy policy commits to a reduction of oil consumption by 50 percent by 2015, 40 percent of the Navy's total energy will come from fossil fuel alternatives and 50 percent of its onshore energy will come from renewable sources by 2020 (Environmental and Energy Study Institute 2009; Paige 2009). Similar low-sulfur fuel regulations in California, including a voluntary state slowdown policy, were found to reduce several pollutants, including sulfur dioxide and particulate matter by as much as 90 percent (Lack et al. 2011).

Based on the analysis presented in Section 3.2 (Air Quality) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low and would still be below applicable state, federal, and USEPA standards and guidelines. Therefore, further analysis of

cumulative impacts on air quality is not warranted. Regulatory framework for greenhouse gases that are related to air quality are discussed below in Section 4.4.4.1.1 (Regulatory Framework).

4.4.4 CLIMATE CHANGE

This section provides background information and an analysis of the cumulative impacts of climate change and greenhouse gas emissions for the Proposed Action. Climate change is also considered in the overall cumulative impacts analysis as another environmental consideration. The Intergovernmental Panel on Climate Change (2007) reports that physical and biological systems on all continents and in most oceans are already being affected by recent climate changes. Global-scale assessment of observed changes shows that it is likely that the increase in greenhouse gas emissions from anthropogenic activities over the last three decades has resulted in an increased temperature, which had a discernible influence on many physical and biological systems. Some of the major potential concerns for the marine environment include sea temperature rise, melting of polar ice, rising sea levels, changes to major ocean current systems, and ocean acidification.

4.4.4.1 Greenhouse Gases

Greenhouse gases are compounds that contribute to the greenhouse effect. The greenhouse effect is a natural phenomenon in which these gases trap heat within the surface-troposphere (lowest portion of the earth's atmosphere) system, causing heating (radiative forcing) at the surface of the earth. The projected warming and more extensive climate-related changes could dramatically alter the region's economy, landscape, character, and quality of life (Le Treut et al. 2007). Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in greenhouse gas emissions from human activities (U.S. Environmental Protection Agency 2012). Without greenhouse gases the planet's surface would be about 60 degrees Fahrenheit (°F) cooler than present; according to the NOAA and National Aeronautics and Space Administration data, the average surface temperature has increased by about 1.2–1.4°F since 1900. If greenhouse gases continue to increase, models predict that the average temperature at the earth's surface could increase from 2.0 to 11.5°F above the 1990 levels by the end of this century (Le Treut et al. 2007).

Predictions of long-term negative environmental impacts due to global warming include sea level rise, changing weather patterns with increases in the severity of storms and droughts, changes to local and regional ecosystems (including the potential loss of species), melting glaciers and sea ice, thawing permafrost, a longer growing season, and shifts in plant and animal ranges.

In 2009, the United States generated about 6,633.2 teragrams (Tg) (or million metric tons) of carbon dioxide (CO_2) equivalents (Co_2e) (U.S. Environmental Protection Agency 2012). The 2009 inventory data (U.S. Environmental Protection Agency 2012) show that greenhouse gases (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) contributed from fossil fuel combustion processes from mobile and stationary sources (all sectors) include approximately:

- 5,505.2 Tg of CO_2
- 686.3 Tg CH_4
- 295.6 Tg N_2O

The 6,633.2 Tg CO_2e generated in 2009 was a decrease from the 7,263.4 Tg CO_2e generated in 2007 (U.S. Environmental Protection Agency 2011). Among domestic transportation sources, light-duty vehicles (including passenger cars and light-duty trucks) represented 64 percent of CO_2 emissions, medium- and

heavy-duty trucks 20 percent, commercial aircraft 6 percent, and other sources 9 percent. Across all categories of aviation, CO_2 emissions decreased by 21.6 percent (38.7 Tg) between 1990 and 2009, including a 59 percent (20.3 Tg) decrease in emission from domestic military operations. To place military aircraft in context with other aircraft CO_2 emissions, in 2009, commercial aircraft generated 111.4 Tg CO_2e, military aircraft generated 14.1 Tg CO_2e, and general aviation aircraft generated 13.3 Tg CO_2e. Military aircraft represent roughly 10 percent of emissions from the overall jet fuel combustion category (U.S. Environmental Protection Agency 2012).

This section begins by providing the background and regulatory framework for greenhouse gases. It then provides a quantitative evaluation of changes in greenhouse gas emissions that would occur under the Proposed Action and analyzes the cumulative impacts of greenhouse gas emissions.

4.4.4.1.1 Regulatory Framework

Federal agencies address emissions of greenhouse gases by reporting and meeting reductions mandated in laws, executive orders and policies. The most recent of these are Executive Order (EO) 13514 *Federal Leadership in Environmental, Energy, and Economic Performance* of 5 October 2009 and EO 13423 *Strengthening Federal Environmental, Energy, and Transportation Management* of 26 January 2007.

Executive Order 13514 shifts the way the government operates by (1) establishing greenhouse gases as the integrating metric for tracking progress in federal sustainability, (2) requiring a deliberative planning process, and (3) linking to budget allocations and Office of Management and Budget scorecards to ensure goal achievement.

The targets for reducing greenhouse gas emissions discussed in EO 13514 for Scope 1 (direct greenhouse gas emissions from sources that are owned or controlled by a federal agency) and Scope 2 (direct greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency) have been set for the DoD at a 34 percent reduction of greenhouse gas from the 2008 baseline by 2020. Scope 3 targets (greenhouse gas emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting) were set at a 13.5 percent reduction. Executive Order 13514 *Strategic Sustainability Performance Plan* submitted to the Council on Environmental Quality on 2 June 2010 contains a guide for meeting these goals.

Executive Order 13423 established a policy that federal agencies conduct their environmental, transportation, and energy-related activities in support of their respective missions in an environmentally economic way. It included a goal of improving energy efficiency and reducing greenhouse gas emissions of the agency through reduction of energy intensity by 3 percent annually through the end of FY 2015, or 30 percent by the end of FY 2015, relative to the baseline of the agency's energy use in FY 2003.

The *Draft NEPA Guidance on Consideration of the Impacts of Climate Change and Greenhouse Gas Emissions* states that "if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2e greenhouse gas emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public" (Council on Environmental Quality 2010).

The Navy is committed to improving energy security and environmental stewardship by reducing reliance on fossil fuels. The Navy is actively developing and participating in energy, environmental, and

climate change initiatives that will increase use of alternative energy and help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the Environmental Readiness Division is taking to implement EO 13514 (U.S. Department of the Navy 2010). The Navy's Task Force Energy is responding to the Secretary of the Navy Energy Goals through energy security initiatives that reduce the Navy's carbon footprint. The Climate Change Roadmap (5-year roadmap) action items, objectives, and desired impacts are organized to focus on strategies, policies and plans; operations and training; investments; strategic communications and outreach; and EA and prediction.

4.4.4.2 Cumulative Greenhouse Gas Impacts

Climate change is a global issue, and greenhouse gas emissions are a concern from a cumulative perspective because individual sources of greenhouse gas emissions are not large enough to have an appreciable impact on climate change. This greenhouse gas analysis considers the incremental contribution of Alternatives 1 and 2 to total estimated U.S. greenhouse emissions and their significance on climate change as compared to the No Action Alternative.

To estimate total greenhouse gas emissions, each greenhouse gas was assigned a global warming potential; that is, the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. For example, CH_4 has a global warming potential of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis (Intergovernmental Panel on Climate Change 2007). To simplify greenhouse gas analyses, total greenhouse gas emissions from a source are often expressed as CO_2 Eq. The CO_2 Eq is calculated by multiplying the emissions of each greenhouse gas by its global warming potential and adding the results together to produce a single, combined emission rate representing all greenhouse gases. While CH_4 and N_2O have much higher global warming potentials than CO_2, CO_2 is emitted in much higher quantities, so it is the overwhelming contributor to CO_2 Eq from both natural processes and human activities. Global warming potential-weighted emissions are presented in terms of equivalent emissions of CO_2, using units of Tg (1 million metric tons, or 1 billion kg) of carbon dioxide equivalents (Tg CO_2 Eq).

Greenhouse gas emissions were calculated (Appendix D, Air Quality Example Calculations) for ships and aircraft, which contribute the majority of emissions associated with training and testing in the Study Area. Greenhouse gas emissions from minor sources such as munitions, weapons platforms, and auxiliary equipment are considered negligible and were not calculated. Ship greenhouse gas emissions were estimated by determining annual ship fuel (typically diesel) use based on proposed activities and multiplying total annual ship fuel consumption by the corresponding emission factors for CO_2, CH_4, and N_2O. Aircraft greenhouse gas emissions were calculated by multiplying jet fuel use rates by the total operating hours, by the corresponding jet fuel emission factors for CO_2, CH_4, and N_2O, and by the total annual sorties. Ship and aircraft greenhouse gas emissions are compared to U.S. 2010 greenhouse gas emissions in Table 4.4-1. The estimated CO_2 Eq emissions from the No Action Alternative and Alternative 1 are 0.0007 percent of the total CO_2 Eq emissions generated by the United States in 2010. The estimated CO_2 Eq emissions from Alternative 2 would increase as a result of increased training and testing activities to about 0.0009 percent of the total CO_2 Eq emissions generated by the United States in 2010.

Based on the analysis presented in Section 3.2 (Air Quality) and the reasons summarized above, the changes in air quality would be measurable, but would still be below applicable standards and

guidelines; therefore the incremental contribution of Alternatives 1 and 2 to cumulative greenhouse gas impacts would be low and further analysis of cumulative impacts is not warranted.

Table 4.4-1: Comparison of Ship and Aircraft Greenhouse Gas Emissions to United States 2010 Greenhouse Gas Emissions

Alternative	Annual Greenhouse Gas Emissions (teragrams CO_2 Eq)	Percentage of U.S. 2010 Greenhouse Gas Emissions
No Action Alternative	0.05	0.0007
Alternative 1	0.05	0.0007
Alternative 2	0.06	0.0009
U.S. 2010 Greenhouse Gas Emissions	6,821.8	

Notes: CO_2 Eq = carbon dioxide equivalent, U.S. = United States
Source: U.S. Environmental Protection Agency 2012

4.4.5 MARINE HABITATS

The analysis presented in Section 3.3 (Marine Habitats) indicates that marine habitats would be affected by acoustic stressors (underwater detonations) and physical disturbance or strikes (interactions with vessels and in-water devices, military expended materials, or seafloor devices). Potential impacts include localized disturbance of the seafloor, cratering of soft-bottom sediments, and structural damage to hard-bottom habitats. Impacts on soft-bottom habitats would be short-term, and impacts on hard bottom would be long-term. The impacts of Alternatives 1 and 2 would be cumulative with other actions that cause similar disturbances. However, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low for the following reasons:

- Most of the proposed activities that might affect marine habitats would occur in areas where hard bottom does not occur.
- Impacts on soft-bottom habitats would be confined to a limited area, and recovery would occur quickly.

Based on the analysis presented in Section 3.3 (Marine Habitats) and the reasons summarized above, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low. Further analysis of cumulative impacts on marine habitats is not warranted.

4.4.6 MARINE MAMMALS

4.4.6.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Based on the analysis presented in Section 3.4 (Marine Mammals) impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on marine mammals include mortality, injury (Level A harassment under the MMPA), and disturbance or behavioral modification (MMPA Level B harassment). Mortality or injury could be caused by underwater explosions or vessel strikes. Injury, in the form of Permanent Threshold Shift (PTS), could also be caused by sonar use. Underwater explosions and sonar use would result in disturbance that meets the definition of MMPA Level A and B harassment. Other relatively short-term activities that might inadvertently harass marine mammals meet the definition of MMPA Incidental Harassment Authorizations. The remaining stressors analyzed in Section 3.4 (Marine Mammals) are not expected to result in mortality or Level A or B harassment. The incremental contribution of these remaining stressors discussed in Sections 3.4.3.3 through 3.4.3.7, to cumulative impacts on marine mammals, would be negligible. The impacts of Alternatives 1 and 2 considered in the

cumulative impacts analysis of this Section 4.4.6 are summarized in Chapter 3, Section 3.4 (Marine Mammals).

4.4.6.2 Impacts of Other Actions

4.4.6.2.1 Overview

The potential impacts of other actions that are relevant to the cumulative impact analysis for marine mammals include the following:

- Mortality associated with vessel strikes, bycatch in fisheries, and entanglement in fishing and other gear
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with water pollution

Most of the other actions and considerations retained for analysis in Table 4.3-1 would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and permitting. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in the maritime traffic and ocean noise subsections. Similarly, many of the actions would result in water pollution. The aggregate impacts of water pollution are addressed in the ocean pollution section (Section 4.4.6.2.5). Bycatch is associated with commercial fishing, and the primary cause of entanglement is commercial fishing. Therefore, these stressors are discussed in the commercial fishing section (Section 4.4.6.3.1).

4.4.6.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Potential impacts on marine mammals from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations include (1) nonauditory injury,[2] (2) permanent loss of hearing, (3) temporary loss of hearing, (4) behavioral change, and (5) masking. The potential effects from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations on any stock of marine mammals from injury (nonauditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in marine mammals due to low-frequency active sonar signal transmissions is not expected to be severe and would be temporary. The operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar with monitoring and mitigation would result in no mortality. The likelihood of low-frequency active sonar transmissions causing marine mammals to strand is negligible (U.S. Department of the Navy 2011).

[2] Nonauditory injury can be defined as not relating to or functioning in hearing (Merriam-Webster 2012); this includes mortality, strike, and lung injury.

4.4.6.2.3 Maritime Traffic and Vessel Strikes

Vessel strikes have been and will continue to be a cause of marine mammal mortality and injury throughout the Study Area. A review of the impacts of vessel strikes on marine mammals is presented in Section 3.4.3.4.1 (Impacts from Vessel Strikes). In particular, certain large whales, such as the blue whale, are more prone to vessel strikes (Berman-Kowalewski et al. 2010; Betz et al. 2011). The most vulnerable marine mammals are thought to be those that spend extended periods at the surface or species whose unresponsiveness to vessel sound makes them more susceptible to vessel collisions (Gerstein 2002; Laist and Shaw 2006; Nowacek et al. 2004). Marine mammals such as dolphins, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes. Most vessel strikes of marine mammals reported involve commercial vessels and occur over or near the continental shelf (Laist et al. 2001). The literature review by Laist et al. (2001) concluded that vessel strikes likely have a negligible impact on the status of most whale populations, but that for small populations, vessel strikes may have considerable population-level impacts. The conservation status and abundance of the species struck would determine in large part whether the injury would have population-level impacts on that species (Laist et al. 2001; Vanderlaan and Taggart 2009). There has never been a Navy vessel strike to a marine mammal in the Study Area during any previous training or testing activities.

Mysticetes

Virtually all of the rorqual whale species have been documented to have been hit by vessels. This includes blue whales (Berman-Kowalewski et al. 2010; Van Waerebeek et al. 2007; Calambokidis 2012), fin whales (as recently as November 2011 in San Diego) (Van Waerebeek et al. 2007; Douglas et al. 2008), sei whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), Bryde's whales (Felix and Van Waerebeek 2005; Van Waerebeek et al. 2007), minke whales (Van Waerebeek et al. 2007), and humpback whales (Lammers et al. 2003; Van Waerebeek et al. 2007; Douglas et al. 2008).

Odontocetes

Sperm whales may be exceptionally vulnerable to vessel strikes as they spend extended periods of time "rafting" at the surface in order to restore oxygen levels within their tissues after deep dives (Jaquet and Whitehead 1996; Watkins et al. 1999). There were also instances in which sperm whales approached vessels too closely and were cut by the propellers (Aguilar de Soto et al. 2006). In general, odontocetes move quickly and seem to be less vulnerable to vessel strikes than other cetaceans; however, most small whale and dolphin species have at least occasionally suffered from vessel strikes including: killer whale (Visser and Fertl 2000; Van Waerebeek et al. 2007); short-finned and long-finned pilot whales (Aguilar et al. 2000; Van Waerebeek et al. 2007); bottlenose dolphin (Bloom and Jager 1994; Wells and Scott 1997; Van Waerebeek et al. 2007); white-beaked dolphin, short-beaked common dolphin, striped dolphin, Atlantic spotted dolphin, and pygmy sperm whales (*Kogia breviceps*) (Van Waerebeek et al. 2007); and spinner dolphin (Camargo and Bellini 2007; Van Waerebeek et al. 2007). Beaked whales documented in vessel strikes include: Arnoux's beaked whale (Van Waerebeek et al. 2007), Cuvier's beaked whale (Aguilar et al. 2000; Van Waerebeek et al. 2007), and several species of *Mesoplodon* (Van Waerebeek et al. 2007). However, evidence suggests that beaked whales may be able to hear the low-frequency sounds of large vessels and thus avoid collision (Ketten 1998).

Pinnipeds

Pinnipeds in general appear to suffer fewer impacts from ship strikes than do cetaceans. This may be due, at least in part, to the large amount of time they spend on land (especially when resting and breeding), and their high maneuverability in the water. However, California sea lions are often attracted to fishing vessels or when food is available onboard or nearby (Hanan et al. 1989), and this may make

them somewhat more at risk of being hit by a vessel during these times. Ship strikes are not a major concern for pinnipeds in general (Antonelis et al. 2006; Marine Mammal Commission 2002; National Marine Fisheries Service 2007).

Sea Otter

Sea otter are not expected to be at risk from vessel strike since they spend the majority of time in the water in nearshore and shallow water areas where Navy vessels generally are not present.

4.4.6.2.4 Ocean Noise

As summarized by the National Academies of Science, the possibility that anthropogenic sound could harm marine mammals or significantly interfere with their normal activities is an issue of concern (National Research Council of the National Academies 2005). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, and communicating with other individuals. Noise can cause behavioral disturbances, mask other sounds (including their own vocalizations), result in injury, and in some cases, even lead to death (Tyack 2009a; Tyack 2009b; Würsig and Richardson 2008). Human-caused noises in the marine environment come from shipping, seismic and geologic exploration, military training, and other types of pulses produced by government, commercial, industry, and private sources. In addition, noise from whale-watching vessels near marine mammals has received a great deal of attention (Wartzok 2009).

NMFS currently states that underwater sound pressure levels (SPLs) above 190 dB root mean square (rms) could cause injury (Level A harassment) in pinnipeds and SPLs above 180 dB rms could cause injury (Level A harassment) in cetaceans. Federal Register Notice (Vol. 70 pp. 1871-1875) established thresholds for behavioral harassment of marine mammals (Level B harassment) at 160 dB rms for pulsed sounds, such as those produced by impact pile driving, and at 120 dB rms for continuous sounds, such as those produced by vibratory pile driving. The pile driving and construction noise from projects in the Hood Canal and Puget Sound would have a cumulative impact on pinniped species as well as cetaceans in the area.

Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present near the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging, there are many unknowns in assessing the specific effects and significance of responses by marine mammals to sound exposures such as what activity the animal is engaged in at the time of the exposure (National Research Council of the National Academies 2003, 2005; Nowacek et al. 2007; Southall et al. 2007). Potential impacts on marine mammals from ocean noise include behavioral reactions, hearing loss in the form of Temporary Threshold Shift (TTS) or PTS, auditory masking, injury, and mortality. Section 3.4.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on marine mammals.

4.4.6.2.5 Ocean Pollution

As discussed in Section 3.4.3 (Environmental Consequences), pollutants from multiple sources are present in, and continue to be released into, the oceans. Elevated concentrations of certain compounds have been measured in tissue samples from marine mammals. Long-term exposure to pollutants poses potential risks to the health of marine mammals, although for the most part, the impacts are just starting to be understood (Reijnders et al. 2008). Section 3.4.3 (Environmental Consequences) provides an overview of these potential impacts, which include organ anomalies and impaired reproduction and immune function (Reijnders et al. 2008).

If the health of an individual marine mammal were compromised by long-term exposure to pollutants, it is possible that this condition could alter the animal's expected response to stressors associated with Alternatives 1 and 2. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by a number of other factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, size, and social position. Synergistic impacts are also possible. For example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter 2005). While the response of a previously stressed animal might be different than the response of an unstressed animal, there are no data available at this time to accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with Alternatives 1 and 2.

4.4.6.3 Coastal Development

Coastal development and increased human populations in coastal areas will continue to have impacts on marine mammals such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds (see Section 3.4, Marine Mammals, for more information on impacts on marine mammals).

4.4.6.3.1 Commercial Fishing

Several commercial fisheries operate in the Study Area. Potential impacts from these activities include marine mammal injury and mortality from bycatch and entanglement. Fisheries have also resulted in profound changes to the structure and function of marine ecosystems that adversely affect marine mammals.

Numerous ports in or near the Study Area contain both commercial and commercial passenger vessel (i.e., recreational) fishing fleets that use the ocean areas within the Study Area.

In 1994, the MMPA was amended to formally address bycatch. Estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer and Read 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period. However, fishery bycatch is likely the most impactful problem presently and may account for the deaths of more marine mammals than any other cause (Northridge 2008, Read 2008, Hamer et al. 2010; Geijer and Read 2013).

As discussed in Section 3.4.3.5 (Entanglement Stressors), entanglement in fishing gear is another major threat to marine mammals in the Study Area. In addition, overfishing of many fish stocks has resulted in significant changes in trophic structure, species assemblages, and pathways of energy flow in marine ecosystems (Jackson et al. 2001; Myers and Worm 2003; Pauly et al. 1998). These ecological changes may have important and likely adverse consequences for populations of marine mammals (DeMaster et al. 2001).

In summary, future commercial fishing activities in the Study Area are expected to result in significant impacts on some marine mammal species based on the relatively high injury and mortality rates associated with bycatch and entanglement. This mortality could result in or contribute to population declines for some species. Ecological changes brought about by commercial fishing are also expected to adversely impact marine mammals in the Study Area.

Along the U.S. west coast, from 1982 to 2010, there have been 272 reported entangled whales (Saez et al. 2012). Entanglements were seen throughout the coast with concentrations near areas where there is higher human population. Identified entangling gear types have included: trap/pot, bottom set longline, and gillnets. Gillnets were the entangling gear type in the majority of reports pre-2000 (64 percent) and trap/pot are the majority post-2000 (45 percent). In the late 1990s, California gillnet regulations changed resulting in a shift and reduction of gillnet fishing effort. Gray and humpback whales are the most frequently reported entangled large whale species along the U.S. west coast. In California, there were a reported 150 gray whales, 47 humpback whales, 27 unidentified whales, 14 sperm whales, 6 minke whales, and 3 fin whales entangled in fishing gear (Saez et al. 2012).

4.4.6.4 Cumulative Impacts on Marine Mammals

The aggregate impacts of past, present actions and reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal species in the Study Area. The impacts are considered significant because vessel strikes, bycatch, and entanglement associated with other actions are expected to result in relatively high rates of injury and mortality that could cause population declines in some species. Alternatives 1 and 2 could also result in injury to individuals of some marine mammal species from underwater explosions, sonar, and vessel strikes. Injury that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of the Proposed Action to the overall injury and mortality would be low compared to other actions. The Navy does not anticipate mortalities to marine mammals within the Study Area as a result of training or testing activities under any of the alternatives. While quantitative estimates of marine mammal mortality from other actions are not available, the total bycatch estimate (lethal takes and serious injuries) for marine mammals for 39 fisheries and 54 marine mammal stocks throughout the United States was 1,887 individual animals in 2005 (National Oceanic and Atmospheric Administration 2011c). Some of these mortalities likely occurred in the Study Area or affected individuals that used the Study Area seasonally.

Ocean noise associated with other actions (see Section 4.4.6.2.4, Ocean Noise) and acoustic stressors (underwater explosions and sonar) associated with Alternatives 1 and 2 could also result in additive behavioral impacts on marine mammals. Other future actions such as pier construction would be expected to result in MMPA Level B harassment. However in the Offshore Area, it is unlikely that these actions and underwater explosions or sonar use would overlap in time and space because these activities are dispersed and the sound sources are intermittent. Training and testing Activities in the Hood Canal may overlap with previously discussed construction events, such as the EHW-2 construction activities. The noise from these activities could combine with training and testing events to make impacts more intense, or cause additive impacts over time to the marine mammals in the area. However, most of these other actions are not compatible with or could interfere with training and testing activities that involve underwater explosions and sonar use. The Navy takes appropriate coordination and scheduling steps (described in Section 3.12, Socioeconomic Resources) to avoid activities that interfere with or are not compatible with training and testing.

It is likely that distant shipping noise, which is more universal and continuous, and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on marine mammals.

As discussed in Section 4.4.6.2.5 (Ocean Pollution), the potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is

possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal.

In summary, based on the analysis presented in Section 3.4 (Marine Mammals), the current aggregate impacts of past and present actions and reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal species in the Study Area. Therefore, cumulative impacts on marine mammals would be significant without consideration of the impacts of Alternatives 1 or 2. Alternatives 1 and 2 would contribute to and increase cumulative impacts, but the relative contribution would be low compared to other actions. Further analysis of cumulative impacts on marine mammals is not warranted.

4.4.7 SEA TURTLES

4.4.7.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on sea turtles include mortality, injury, and short-term disturbance or behavioral modification. Mortality or injury could be caused by underwater explosions or vessel strikes. Injury, in the form of PTS, could also be caused by sonar use. Noninjurious impacts of underwater explosions and sonar use would include short-term disturbance or behavioral modification. The Navy's Annual Model-Predicted Impacts on Leatherback Sea Turtles (*Dermochelys coriacea*) from Explosions for Training and Testing Activities under the No Action Alternative, Alternative 1, and Alternative 2 are presented in Table 3.5-5 and are predicted to be zero for TTS, PTS, Gastrointestinal Tract Injury, Slight Lung Injury, and Mortality. Leatherback sea turtles (*Dermochelys coriacea*) are found in the Study Area while other species of sea turtle were found to be extralimital species to the Study Area. Therefore the Leatherback sea turtle would be more likely to be affected, but is still not likely to be adversely affected, by the remaining stressors analyzed in Section 3.5 (Sea Turtles). The incremental contribution of these remaining stressors to cumulative impacts on sea turtles would be negligible. Therefore, these stressors are not considered further in the cumulative impacts analysis.

4.4.7.2 Impacts of Other Actions

The potential impacts of other actions that are relevant to the cumulative impact analysis for sea turtles include the following:

- Mortality associated with vessel strikes, bycatch in fisheries, entanglement, and stressors associated with coastal development and human use of coastal environments (e.g., beach vehicular driving, power plant entrainment [sea turtles being caught in power plant outflow water], etc.)
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with ocean pollution
- Habitat loss related to coastal development

Most of the other actions and considerations retained for analysis in Section 3.5 (Sea Turtles) would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and planning. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels. Rather than discussing

these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in maritime traffic (see Section 4.4.6.2.3, Maritime Traffic and Vessel Strikes) and ocean noise (see Section 4.4.6.2.4, Ocean Noise). Similarly, many of the actions would result in ocean pollution. The aggregate impacts of water pollution are addressed below in the ocean pollution section (see Section 4.4.6.2.5, Ocean Pollution). Bycatch is associated with commercial fishing, and the primary cause of entanglement is commercial fishing. Therefore, these stressors are discussed below in the commercial fishing section (see Section 4.4.6.3.1, Commercial Fishing).

4.4.7.3 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and continued increases are expected in the future. Vessel strikes have been and will continue to be a cause of sea turtle mortality and injury throughout portions of the Study Area, specifically the offshore area, where sea turtles regularly occur. Because of the wide dispersal of large vessels in open ocean areas and the widespread, scattered distribution of turtles at sea, strikes during open-ocean transits are unlikely.

Some vessel strikes would cause temporary reversible impacts, such as diverting the turtle from its previous activity or causing minor injury. A National Research Council report qualitatively ranked the relative importance of various mortality factors for sea turtles. Vessel strikes were ranked 10th, behind leading factors of shrimp trawling and other fisheries (National Research Council 1990). Major strikes would cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition. Much of what is written about recovery from vessel strikes is inferred from observing individuals some time after a strike. Numerous living sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls, suggesting that not all vessel strikes are lethal (Hazel et al. 2007, Lutcavage et al. 1997). Conversely, fresh wounds on some stranded animals may strongly suggest a vessel strike as the cause of death. The actual incidence of recovery versus death is not known, given available data.

4.4.7.4 Ocean Noise

Potential impacts on sea turtles from ocean noise include behavioral reactions, hearing loss in the form of TTS or PTS, auditory masking, injury, and mortality. Section 3.5.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on sea turtles.

4.4.7.5 Ocean Pollution

Marine debris can also be a problem for sea turtles through entanglement or ingestion. Sea turtles can mistake debris for prey; one study found 37 percent of dead leatherbacks to have ingested various types of plastic (Mrosovsky et al. 2009). Other marine debris, including abandoned fishing gear and cargo nets, can entangle and drown turtles in all life stages.

4.4.7.6 Commercial Fishing

Bycatch is one of the most serious threats to the recovery and conservation of sea turtle populations (National Research Council 1990; Wallace et al. 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al. 2010).

Other fisheries that result in sea turtle bycatch in the Study Area include pelagic fisheries for swordfish, tuna, shark, and billfish; purse seine fisheries for tuna; commercial and recreational rod and reel fisheries; gillnet fisheries for shark; driftnet fisheries; and bottom longline fisheries (National Marine Fisheries Service 2009a).

4.4.7.7 Coastal Development

Coastal development and increased human populations in coastal areas will continue to have impacts on sea turtles such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds (see Section 3.5, Sea Turtles, for more information on impacts on sea turtles).

4.4.7.8 Cumulative Impacts on Sea Turtles

The current aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect, but are not likely to adversely affect sea turtles. These aggregate impacts are considered significant because bycatch, vessel strikes, entanglement and other stressors associated with other actions may result in high rates of injury and mortality that could cause population declines to ESA-listed species, such as the leatherback sea turtle (*Dermochelys coriacea*), the loggerhead (*Caretta caretta*), the olive ridley (*Lepidochelys olivacea*), and the green turtle (*Chelonia mydas*), or inhibit species recovery. Alternatives 1 and 2 could also result in injury and mortality to individual sea turtles from underwater explosions, sonar, and vessel strikes. Injury and mortality that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 and 2 to the overall injury and mortality would be low compared to other actions.

Ocean noise associated with other actions and acoustic stressors (underwater explosions and sonar) associated with Alternatives 1 and 2 could also result in additive behavioral impacts on sea turtles. Other future actions such as operation of wave and tidal energy facilities would be expected to result in similar impacts. However, it is unlikely that these actions and underwater explosions or sonar use would overlap in time and space because all of these activities are widespread and the sound sources are intermittent. Furthermore, most of these other actions are not compatible with or could interfere with training and testing activities that involve underwater explosions and sonar use. The Navy takes appropriate steps to avoid activities that interfere with or are not compatible with training and testing.

It is likely that distant shipping noise (which is more pervasive and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on sea turtles.

The potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, there are no data indicating that a sea turtle affected by ocean pollution would be more susceptible to stressors associated with Alternatives 1 and 2.

In summary, based upon the analysis in Section 3.5 (Sea Turtles), the current aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect, but are not likely to adversely affect sea turtles. Therefore, cumulative impacts on sea turtles would be significant without consideration of the impacts of Alternatives 1 and 2. Alternatives 1 and 2 would contribute to and

increase cumulative impacts, but the relative contribution would be low compared to other actions. Further analysis of cumulative impacts on sea turtles is not warranted.

4.4.8 BIRDS

4.4.8.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on birds include mortality, injury, and short-term disturbance or behavioral modification. Mortality or injury could be caused by underwater explosions, air strikes, or vessel strikes. Noninjurious impacts of underwater explosions and sonar use would include short-term disturbance or behavioral modification. The Navy's ESA determinations presented in Table 3.6-3 are "no effect" or "may affect, not likely to adversely affect" for the remaining stressors analyzed in Section 3.6 (Birds). The incremental contribution of these remaining stressors to cumulative impacts on Birds would be negligible. Therefore, these stressors are not considered further in the cumulative impacts analysis. The impacts of Alternatives 1 and 2 considered in the cumulative impacts analysis are summarized in Table 3.6-10 (Summary of Endangered Species Act Effects Determinations for Birds, for the Preferred Alternative).

4.4.8.2 Impacts of Other Actions

The potential impacts of other actions that are relevant to the cumulative impact analysis for birds include the following:

- Incidental mortality from interactions with commercial and recreational fishing gear
- Predation by introduced species
- Disturbance and degradation of nesting and foraging areas by humans and domesticated animals
- Noise Pollution from construction and other human activities
- Nocturnal collisions with power lines and artificial lights
- Collisions with aircraft
- Pollution such as that from oil spills and plastic debris
- Disease, storms, and harmful algal blooms
- Long-term climate change

Most of the other actions and considerations retained for analysis in Section 3.6 (Birds) would include acoustic stressors (sonar and other underwater active acoustic sources, explosive detonations, vessel noise, and aircraft noise), physical disturbance and strikes (aircraft, vessels and in-water devices, military expended materials [non-explosive]), and ingestion (military expended materials other than ordnance). Exceptions include the actions listed under environmental regulations and planning. Many of the actions would also result in noise from sources other than vessels. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations." Similarly, many of the actions would result in ocean pollution. The aggregate impacts of water pollution are addressed below in the ocean pollution section (Section 4.4.8.2.3, Ocean Pollution).

4.4.8.2.1 Maritime Traffic, Vessel Strikes, Air Traffic, and Air Strikes

Maritime traffic has increased over the past 50 years, and continued increases are expected in the future. Vessel strikes have been and will continue to be a cause of seabird mortality and injury throughout portions of the Study Area. Because of the wide dispersal of large vessels in open ocean areas and the widespread, scattered distribution of seabirds at sea, strikes during open-ocean transits are unlikely.

Some vessel strikes would cause temporary reversible impacts, such as diverting the seabird from its previous activity or causing minor injury. Major strikes would cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a seabird's recovery from a strike may be influenced by its age, reproductive state, and general condition. Much of what is written about recovery from vessel strikes is inferred from observing individuals some time after a strike. Fresh wounds on some stranded animals may strongly suggest a vessel strike as the cause of death. The actual incidence of recovery versus death is not known, given available data.

Thousands of birds are struck each year by civilian and military aircraft. The Federal Aviation Administration annually reports at least 2,300 wildlife related strikes involving civilian aircraft, and the Air Force and Navy report at least an additional 3,000 strikes a year. Pilots and crew use the same airspace as large concentrations of birds, and in an effort to provide the safest conditions for flying possible, the DoD continually implements and improves its aviation programs. One program that it implements is called the Bird Aircraft Strike Hazard (BASH) prevention program. Radar is one of the most effective tools for detecting bird movements. Many types of radar are used at different scales; the Doppler capability of weather surveillance can show the direction and speed of migrating bird flocks up to 60 nm from an airfield during the day or the night (U.S. Department of Defense 2010).

In local airfield environments, mobile marine radars can track real-time movements of individual birds or flocks adjacent to and in a 6–8 mi. (9.7–12.9 km) radius of runways. The Air Force and Navy are developing and testing several "bird radars" to determine which models and configurations can best isolate specific locations of birds where aircraft operations can be modified and environmental management strategies applied to reduce air strikes. Computer models use radar data, historic weather conditions, Audubon Society Christmas Bird Count Data, bird strike reports, and other historical data to help predict spatial and temporal patterns of bird movements. One model, a predictive Bird Avoidance Model (BAM), was developed using geographic information system (GIS) technology as a key tool for analysis and correlation of bird habitat, migration, and breeding characteristics, combined with key environmental and geospatial data. Integral to a successful BASH program is a good working relationship with airport managers and the consistent reporting and identification of species involved in strike events. By identifying the wildlife species involved and the location of the strike, researchers and airport managers can better understand why the species is attracted to a particular area of the airport or training route (U.S. Department of Defense 2010).

4.4.8.2.2 Noise

Potential impacts on birds from ocean noise include behavioral reactions, hearing loss in the form of TTS or PTS, auditory masking, injury, and mortality. Section 3.6.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on seabirds.

4.4.8.2.3 Ocean Pollution

Marine debris can also be a problem for seabirds through entanglement or ingestion. Seabirds can mistake debris for prey and 44 percent of seabirds are affected by plastic marine debris (Cousteau 2012). Other marine debris, including abandoned fishing gear and cargo nets, can entangle and drown seabirds in all life stages.

4.4.8.2.4 Coastal Development

Coastal development and increased human population in coastal areas will continue to have impacts on birds related to increased tourism, non-point source pollution and runoff, habitat encroachment, and degradation of nearshore water quality and seagrass beds (see Section 3.6, Birds, for more information on Coastal Development and its impacts on birds).

4.4.8.3 Cumulative Impacts on Birds

The aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect on birds. These aggregate impacts are considered significant because air strikes, vessel strikes, entanglement and other stressors associated with other actions are expected to result in high rates of injury and mortality that could cause population declines to ESA-listed species or inhibit species recovery. Alternatives 1 and 2 could also result in injury and mortality to individual birds from underwater explosions, sonar, and strikes. Injury and mortality that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 and 2 to the overall injury and mortality would be low compared to other actions such as bycatch, storm runoff, plastic debris, and other non-military activities.

Seabird distribution, abundance, breeding, and other behaviors are affected by cyclical environmental events such as the El Niño Southern Oscillation and Pacific Decadal Oscillation in the Pacific Ocean (Vandenbosch 2000). In the long term, climate change could be the largest threat to seabirds (North American Bird Conservation Initiative 2010). Climate change effects include changes in air and sea temperatures, precipitation, the frequency and intensity of storms, pH level of sea water, and sea level. These changes could affect overall marine productivity, which could affect the food resources, distribution, and reproductive success of seabirds (Aebischer et al. 1990; Congdon et al. 2007). The projection for global sea levels rise from 2090 to 2099 is up to 1 ft. (0.3 m) relative to 1980 to 1999 levels (Church and White 2006; Solomon et al. 2007). As a result, seabird nesting colonies that occur along sections of coastlines undergoing sea level rise may experience a loss of nesting habitat (Congdon et al. 2007; Gilman and Ellison 2009; Gilman et al. 2008; Hitipeuw et al. 2007; Mullane and Suzuki 1997).

Ocean noise associated with other actions and acoustic stressors (underwater explosions and sonar) associated with Alternatives 1 and 2 could also result in additive behavioral impacts on birds. Other future actions, such as construction of wharfs, would be expected to result in similar impacts. These actions and underwater explosions or sonar use may overlap in time and space; however, all of these activities are widespread, and the sound sources are intermittent. Furthermore, most of these other actions are not compatible with or could interfere with training and testing activities that involve underwater explosions and sonar use. The Navy takes appropriate steps to avoid activities that interfere with or are not compatible with training and testing.

It is likely that distant shipping and aircraft noise (which is more pervasive and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping and aircraft noise, and sounds associated with underwater explosions and sonar use, would result in harmful additive impacts on birds.

The potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, there are no data indicating that a seabird affected by ocean pollution would be more susceptible to stressors associated with Alternatives 1 and 2.

In summary, based upon the analysis in Section 3.6 (Birds), and the reasons summarized above, the incremental contribution of Alternatives 1 and 2 to cumulative impacts to bird populations would be low. Therefore, further analysis of cumulative impacts on birds is not warranted.

4.4.9 MARINE VEGETATION

The analysis presented in Section 3.7 (Marine Vegetation) indicates that marine vegetation could be affected by acoustic stressors (underwater explosions) and physical stressors (interactions with vessels and in-water devices, military expended materials, or seafloor devices). Potential impacts include localized disturbance and mortality. Recovery would occur quickly, and population level impacts are not anticipated. The impacts of Alternatives 1 or 2 would be cumulative with other actions that cause disturbance and mortality of marine vegetation. However, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low for the following reasons:

- Most of the proposed activities would occur in areas where seagrasses and other attached marine vegetation do not grow.
- Impacts would be localized, recovery would occur quickly, and no population level impacts would be expected.
- Alternatives 1 and 2 would not result in impacts that have been historically significant to marine vegetation. For example, Alternatives 1 and 2 would not increase nutrient loading, which can cause algal blooms, decrease light penetration, and impact photosynthesis of seagrasses. Furthermore, Alternatives 1 and 2 would not result in long-term or widespread changes in environmental conditions, such as turbidity, salinity, pH, or water temperature that could impact marine vegetation.
- The Proposed Action would have no effect on ESA-listed species of marine vegetation and would not result in the destruction or adverse modification of critical habitat.

Based on the analysis presented in Section 3.7 (Marine Vegetation) and the reasons summarized above, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be low. Further analysis of cumulative impacts on marine vegetation is not warranted.

4.4.10 MARINE INVERTEBRATES

The analysis presented in Section 3.8 (Marine Invertebrates) indicates that marine invertebrates could be affected by acoustic stressors (tactical acoustic sonar, other acoustic devices, pile driving, underwater explosions, weapons firing noise, aircraft noise, vessel noise), electromagnetic stressors, physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices), entanglement (cables and wires, parachutes), and ingestion (military expended materials). Potential impacts include short-term behavioral and physiological responses. Some stressors could also result in injury or mortality to a relatively small number of individuals, but not to ESA-listed corals. No population-level impacts are anticipated. Stressors from Alternatives 1 and 2 would have no effect or would be not likely to adversely affect ESA-listed corals.

Based upon the analysis in Section 3.8 (Marine Invertebrates), the invertebrate mortality impacts of Alternatives 1 and 2 would be cumulative with other actions that cause mortality (e.g., commercial fishing). However, the incremental contribution of Alternatives 1 and 2 to cumulative impacts would be negligible. Therefore, further analysis of cumulative impacts on marine invertebrates is not warranted.

4.4.11 FISH

4.4.11.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

Based on the analysis presented in Section 3.9 (Fish), impacts of Alternatives 1 and 2 that might contribute to cumulative impacts on fish include mortality, injury, and disturbance or behavioral modification. Mortality or injury could be caused by underwater explosions or vessel strikes. Injury, in the form of PTS, could also be caused by sonar use. The remaining stressors analyzed in Section 3.9 (Fish) are not expected to result in mortality. The incremental contribution of these remaining stressors to cumulative impacts on fish would be negligible. These stressors are discussed in Sections 3.9.3.1 through 3.9.3.6. The impacts of Alternatives 1 and 2 considered in the cumulative impacts analysis are summarized in Section 3.9 (Fish).

4.4.11.2 Impacts of Other Actions

4.4.11.2.1 Overview

The potential impacts of other actions that are relevant to the cumulative impact analysis for fish include the following:

- Mortality associated with vessel strikes, commercial fisheries, bycatch, and entanglement in fishing and other gear
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with water pollution

Most of the other actions and considerations retained for analysis in Table 4.3-1 would include operation of marine vessels. Exceptions include the actions listed under environmental regulations and permitting. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis includes vessel strikes and underwater noise. Many of the actions would also result in underwater noise from sources other than vessels, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as “other environmental considerations” in the maritime traffic and ocean noise subsections. Similarly, many of the actions would result in water pollution. The aggregate impacts of water pollution are addressed in the ocean pollution section (see Section 4.4.6.2.5). Commercial fishing and overfishing is the primary cause of stress and entanglement. Therefore, these stressors are discussed in the commercial fishing section (see Section 4.4.6.3.1).

4.4.11.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Potential impacts on fish from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations include (1) nonauditory injury, (2) permanent loss of hearing, (3) temporary loss of hearing, (4) behavioral change, and (5) masking.

Studies have examined the effects of the sound exposures from Surveillance Towed Array Sensor System Low-Frequency Active sonar on fish hearing (Kane et al. 2010; Popper et al. 2007). Hearing was measured both immediately post exposure and for several days thereafter. Maximum received sound pressure levels were 193 dB referenced to 1 micropascal for 324 or 628 seconds. Catfish and some specimens of rainbow trout showed 10–20 dB of hearing loss immediately after exposure to the low-frequency active sonar when compared to baseline and control animals; however, another group of rainbow trout showed no hearing loss. Recovery in trout took at least 48 hours, but studies were not

completed. The different results between rainbow trout groups is difficult to understand, but may be due to developmental or genetic differences in the various groups of fish. Catfish hearing returned to, or close to, normal within about 24 hours after exposure to low-frequency active sonar. Furthermore, examination of the inner ears of the fish during necropsy (note: maximum time fish were held post exposure before sacrifice was 96 hours) revealed no differences from the control groups in cilliary bundles or other features indicative of hearing loss (Kane et al. 2010).

The potential effects from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations on any stock of fish from injury (nonauditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any fish from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in fish due to low-frequency active sonar signal transmissions is not expected to be severe and would be temporary. The operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar with monitoring and mitigation could result in temporary or permanent hearing loss, or could not affect them at all depending on the species and proximity to the Sonar.

4.4.11.2.3 Maritime Traffic and Vessel Strikes

Vessels and in-water devices do not normally collide with adult fish, most of which can detect and avoid them. One study on fishes' behavioral responses to vessels showed that most adults exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders, reducing the potential for vessel strikes (Jørgensen et al. 2004). Misund (1997) found that fishes ahead of a ship that showed avoidance reactions did so at ranges of 160–490 ft. (48.8–149.4 m). When the vessel passed over them, some fishes responded with sudden escape responses that included lateral avoidance or downward compression of the school. Conversely, Rostad et al. (2006) observed that some fishes are attracted to different types of vessels (e.g., research vessels, commercial vessels) of varying sizes, noise levels, and habitat locations. Fish behavior in the vicinity of a vessel is therefore quite variable, depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Early life stages of most fishes could be displaced by vessels and not struck in the same manner as adults of larger species. However, a vessel's propeller movement or propeller wash could entrain early life stages. The low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses among herring, but avoidance ended within 10 seconds after the vessel departed (Chapman and Hawkins 1973). Because a towed in-water device is continuously moving, most fishes are expected to move away from it or to follow behind it, in a manner similar to their responses to a vessel. When the device is removed, most fishes would simply move to another area.

4.4.11.2.4 Ocean Noise

Underwater noise is a threat to marine fishes. However, the physiological and behavioral responses of marine fishes to underwater noise have been investigated for only a limited number of species (Codarin et al. 2009, Popper 2003, Slabbekoorn et al. 2010, Wright et al. 2010, Popper and Hastings 2009a, b). In addition to vessels, other sources of underwater noise include seismic activity (Popper and Hastings 2009a). Information on fish hearing is provided in Section 3.9.2.1 (Hearing and Vocalization), with further discussion in Section 3.9.3.1 (Acoustic Stressors).

4.4.11.2.5 Ocean Pollution

Pollution primarily impacts coastal fishes that occur near the sources of pollution. However, global oceanic circulation patterns result in a considerable amount of marine pollutants and debris scattered throughout the open ocean (Crain et al. 2009). Pollutants in the marine environment that may impact

marine fishes include organic pollutants (e.g., pesticides, herbicides, polycyclic aromatic hydrocarbons, flame retardants, and oil), inorganic pollutants (e.g., heavy metals), and debris (e.g., plastics and wastes from dumping at sea) (Pews Oceans Commission 2003). High chemical pollutant levels in marine fishes may cause behavioral changes, physiological changes, or genetic damage in some species (Goncalves et al. 2008, Moore 2008, Pews Oceans Commission 2003, van der Oost et al. 2003). Bioaccumulation of pollutants (e.g., metals and organic pollutants) is also a concern, particularly in terms of human health, because people consume top predators with high pollutant loads. Bioaccumulation is the net buildup of substances (e.g., chemicals or metals) in an organism directly from contaminated water or sediment through the gills or skin, from ingesting food containing the substance, or from ingestion of the substance itself (Newman 1998, Moore 2008). Entanglement in abandoned commercial and recreational fishing gear has also caused pollution-related declines for some marine fishes; some species are more susceptible to entanglement by marine debris than others (Musick et al. 2000).

4.4.11.3 Coastal Development

Coastal development and increased human population activities in coastal areas, such as increased tourism, non-point source pollution and runoff, power plant entrainment, and degradation of nearshore water quality and seagrass beds, will continue to have impacts on fish (see Section 3.9, Fish, for more information on impacts on fish).

4.4.11.3.1 Commercial Fishing

Overfishing is the most serious threat that has led to the listing of ESA-protected marine species, with habitat loss also contributing to extinction risk (Crain et al. 2009, Kappel 2005, Cheung et al. 2007, Dulvy et al. 2003, Jonsson et al. 1999, Limburg and Waldman 2009, Musick et al. 2000). Approximately 30 percent of the United States-managed fishery stocks are overfished (National Marine Fisheries Service 2009b). Overfishing occurs when fishes are harvested in quantities above a sustainable level. Overfishing impacts targeted species, and non-targeted species (or “bycatch” species) that often are prey for other fishes and marine organisms. Bycatch may also include seabirds, turtles, and marine mammals. Additionally, in recent decades the marine fishes being targeted have changed such that when higher-level predators become scarce, different organisms on the food chain are subsequently targeted; this has negative implications for entire marine food webs (Crain et al. 2009, Pauly and Palomares 2005). Other factors, such as fisheries-induced evolution and intrinsic vulnerability to overfishing, have been shown to reduce the abundance of some populations (Kauparinen and Merila 2007). Fisheries-induced evolution describes a change in genetic composition of the population that results from intense fishing pressure, such as a reduction in the overall size and growth rates of fish in a population. Intrinsic vulnerability describes certain life history traits (e.g., large body size, late maturity age, low growth rate) that result in a species being more susceptible to overfishing than others (Cheung et al. 2007).

4.4.11.4 Cumulative Impacts on Fish

The aggregate impacts of past, present, and reasonably foreseeable future actions may have a significant impact to fish. These aggregate impacts are considered significant because overfishing, vessel strikes, entanglement and other stressors associated with other actions are expected to result in high rates of injury and mortality that could cause population declines to ESA-listed species or inhibit species recovery. Alternatives 1 and 2 could also result in injury and mortality to individual fish from underwater explosions, sonar, and strikes. Injury and mortality that might occur under Alternatives 1 and 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 and 2 to the overall injury and mortality would be low compared to other actions.

It is likely that distant shipping and aircraft noise (which is more pervasive and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping and aircraft noise, and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on fish.

The potential also exists for the impacts of ocean pollution and acoustic stressors associated with Alternatives 1 and 2 to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, there are no data indicating that a fish affected by ocean pollution would be more susceptible to stressors associated with Alternatives 1 and 2.

In summary, based upon the analysis in Section 3.9 (Fish), the current aggregate impacts of past, present and reasonably foreseeable future actions may have a significant effect, but are not likely to adversely affect fish. Therefore, cumulative impacts on fish would be significant without consideration of the impacts of Alternatives 1 and 2. Alternatives 1 and 2 would contribute to, and increase, cumulative impacts, but the relative contribution would be low compared to other actions. Further analysis of cumulative impacts on fish is not warranted.

4.4.12 Cultural Resources

4.4.12.1 Impacts of Alternatives 1 and 2 That May Contribute to Cumulative Impacts

As discussed in Section 3.10 (Cultural Resources), Alternatives 1 and 2 could result in impacts on submerged prehistoric sites and previously unidentified submerged historic resources if certain training and testing activities are conducted where these resources occur. Stressors that could impact cultural resources include underwater explosions on or near the bottom, use of towed-in-water devices, and use of ocean bottom deployed devices. Because cultural resources are considered nonrenewable resources, these impacts would be considered long-term and permanent.

The Navy routinely avoids locations of known obstructions to prevent damage to sensitive Navy equipment and vessels and to ensure the accuracy of training and testing exercises. Known obstructions include some historic shipwrecks; however, it is unknown if all submerged obstructions, historic shipwrecks, or other cultural resources have yet been discovered in the Study Area.

4.4.12.2 Impacts of Other Actions

With a few exceptions, most of the other actions retained for cumulative impacts analysis (see Table 4.3-1) would involve some form of disturbance to the ocean bottom. Exceptions include environmental regulations and planning actions, ocean pollution, and most forms of ocean noise. Actions that would disturb the ocean bottom could impact submerged cultural resources. For example, ocean bottom disturbance would occur from construction related activities such as ship anchoring, and installation of wind turbine piers. Any physical disturbance on the continental shelf and ocean floor could inadvertently damage or destroy submerged prehistoric sites and submerged historic resources.

The other actions that result in ocean bottom disturbance require some form of federal authorization or permitting. Therefore, requirements of the National Historic Preservation Act apply to actions in territorial waters. Federal agency procedures have been implemented to identify cultural resources, avoid impacts, and mitigate if impacts cannot be avoided. For example, the Bureau of Ocean Energy Management, Regulation and Enforcement has procedures in place to identify the probability for the presence of submerged historic resources and the locations submerged prehistoric sites shoreward from

the 148 ft. (45.1 m) isobath, and for project redesign and relocation to avoid identified resources (Minerals Management Service 2007). Nonetheless, inadvertent impacts could occur if unidentified submerged cultural resources are present.

4.4.12.3 Cumulative Impacts on Cultural Resources

Impacts on submerged cultural resources from other actions would typically be avoided or mitigated through implementing federal agency programs. However, impacts could occur if avoidance or mitigation measures are not implemented or if inadvertent disturbance or destruction of unidentified resources occurs. Disturbance or destruction of submerged prehistoric sites would diminish the overall archaeological record and decrease the potential for meaningful research on Paleomarine traditions (6,500–5,000 Before Present) and early explorers of the Northwest coast (1700s–1800s) occupations. Disturbance or destruction of submerged historic sites, including shipwrecks, would diminish the overall record for these resources and decrease the potential for meaningful research on these resources. Based upon the analysis in Section 3.10 (Cultural Resources), when considered with other actions, Alternatives 1 and 2 would contribute to and increase the cumulative impacts on submerged prehistoric and historic resources. Further analysis of cumulative impacts on cultural resources is not warranted.

4.4.13 Native American and Alaska Native Traditional Resources

As discussed in Section 3.11 (Native American and Alaska Native Traditional Resources), impacts are not expected on traditional resources, such as usual and accustomed fishing areas, because inaccessibility to areas of co-use would be temporary, and impacts to availability of marine species are not expected.

4.4.14 Socioeconomics

The analysis in Section 3.12 (Socioeconomic Resources) indicates that the impacts of Alternatives 1 and 2 on socioeconomic resources would be negligible. Alternatives 1 and 2 are not expected to contribute to cumulative socioeconomic impacts. Therefore, further analysis of cumulative impacts on socioeconomic resources is not warranted.

4.4.15 Public Health and Safety

The analysis presented in Section 3.13 (Public Health and Safety) indicates that the impacts of Alternatives 1 and 2 on public health and safety would be negligible. Alternatives 1 and 2 are not expected to contribute incrementally to cumulative health and safety impacts. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 Summary of Cumulative Impacts

Marine mammals, sea turtles, birds, and fish are the primary resources of concern for cumulative impacts analysis:

- Past human and natural activities have impacted these resources to the extent that several marine mammal species, all sea turtles, one bird, and multiple fish species occurring in the Study Area are ESA-listed.
- These resources would be impacted by multiple ongoing and future actions.
- Explosive detonations and vessel strikes under the No Action Alternative, Alternative 1, and Alternative 2 have the potential to disturb, injure, or kill marine mammals, sea turtles, birds, and fish.

The aggregate impacts of past, present, and other reasonably foreseeable future actions are expected to result in significant impacts on some marine mammals, Leatherback sea turtles (*Dermochelys coriacea*), some birds, and some fish species in the Study Area. The No Action Alternative, Alternative 1, or Alternative 2 would contribute to cumulative impacts, but the relative contribution would be low compared to other actions. Compared to the potential mortality, stranding, and injury resulting from commercial ship strikes and bycatch, entanglement, ocean pollution and other human causes, the potential for mortality, strandings or injury resulting from Navy training and testing activities is estimated to be orders of magnitude lower (tens of animals versus hundreds of thousands of animals) (Culik 2004, International Council for the Exploration of the Sea 2005, Read et al. 2006).

The analysis presented in this chapter and Chapter 3 (Affected Environment and Environmental Consequences) indicates that the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts on sediments and water quality, air quality, marine habitats, marine vegetation, marine invertebrates, socioeconomic resources, Native American and Alaska Native, and public health and safety would be negligible. When considered with other actions, the No Action Alternative, Alternative 1, or Alternative 2 might contribute to cumulative impacts on submerged prehistoric and historic resources, if such resources are present in areas where bottom-disturbing training and testing activities take place. The No Action Alternative, Alternative 1, or Alternative 2 would also make an incremental contribution to greenhouse gas emissions, representing approximately 0.0007 percent, 0.0007 percent, and 0.0009 percent of U.S. 2010 greenhouse gas emissions, respectively.

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5 Standard Operating Procedures, Mitigation, and Monitoring

TABLE OF CONTENTS

5 STANDARD OPERATING PROCEDURES, MITIGATION, AND MONITORING 5-1

5.1 STANDARD OPERATING PROCEDURES 5-1
5.1.1 GENERAL SAFETY 5-2
5.1.2 VESSEL SAFETY 5-2
5.1.3 AIRCRAFT SAFETY 5-3
5.1.4 LASER PROCEDURES 5-3
5.1.4.1 Laser Operators 5-3
5.1.4.2 Laser Activity Clearance 5-3
5.1.5 WEAPONS FIRING PROCEDURES 5-3
5.1.5.1 Notice to Mariners 5-3
5.1.5.2 Weapons Firing Range Clearance 5-4
5.1.6 SWIMMER DEFENSE TESTING PROCEDURES 5-4
5.1.7 UNMANNED AIRCRAFT SYSTEM PROCEDURES 5-4
5.1.8 UNMANNED SURFACE VEHICLE AND UNMANNED UNDERWATER VEHICLE PROCEDURES 5-4
5.1.9 TOWED IN-WATER DEVICE PROCEDURES 5-4
5.1.10 BEST MANAGEMENT PRACTICES 5-5
5.2 INTRODUCTION TO MITIGATION 5-5
5.2.1 REGULATORY REQUIREMENTS FOR MITIGATION 5-6
5.2.2 OVERVIEW OF MITIGATION APPROACH 5-7
5.2.2.1 Lessons Learned from Previous Environmental Impact Statements/Overseas Environmental Impact Statements 5-7
5.2.2.2 Protective Measures Assessment Protocol 5-8
5.2.3 ASSESSMENT METHOD 5-8
5.2.3.1 Effectiveness Assessment 5-8
5.2.3.2 Operational Assessment 5-10
5.3 MITIGATION ASSESSMENT 5-11
5.3.1 LOOKOUT PROCEDURAL MEASURES 5-11
5.3.1.1 Specialized Training 5-12
5.3.1.2 Lookouts 5-13
5.3.2 MITIGATION ZONE PROCEDURAL MEASURES 5-25
5.3.2.1 Acoustic Stressors 5-28
5.3.2.2 Physical Disturbance and Strike 5-45
5.3.3 MITIGATION AREAS 5-49
5.3.4 MITIGATION MEASURES CONSIDERED BUT ELIMINATED 5-49
5.3.4.1 Previously Considered but Eliminated 5-49
5.3.4.2 Previously Accepted but Now Eliminated 5-59
5.4 MITIGATION SUMMARY 5-60
5.5 MONITORING AND REPORTING 5-69
5.5.1 APPROACH TO MONITORING 5-69
5.5.1.1 Integrated Comprehensive Monitoring Plan Top-Level Goals 5-69
5.5.1.2 Scientific Advisory Group Recommendations 5-70
5.5.2 ACTIVITY SPECIFIC MONITORING 5-71
5.5.3 REPORTING 5-72
5.5.3.1 Exercise and Monitoring Reporting 5-72

5.5.3.2 Additional Reporting Requirements 5-72
5.5.3.3 Stranding Response Plan 5-73
5.5.3.4 Bird Strikes 5-73

LIST OF TABLES

TABLE 5.3-1: SIGHTABILITY BASED ON G(0) VALUES FOR MARINE MAMMAL SPECIES IN THE STUDY AREA 5-22
TABLE 5.3-2: PREDICTED RANGE TO EFFECTS AND RECOMMENDED MITIGATION ZONES 5-27
TABLE 5.4-1: SUMMARY OF RECOMMENDED MITIGATION MEASURES 5-62
TABLE 5.4-2: MITIGATION IDENTIFICATION AND IMPLEMENTATION 5-67

LIST OF FIGURES

FIGURE 5.2-1: FLOWCHART OF PROCESS FOR DETERMINING PROPOSED MITIGATION MEASURES 5-9

5 STANDARD OPERATING PROCEDURES, MITIGATION, AND MONITORING

This chapter describes the United States (U.S.) Department of the Navy (Navy) standard operating procedures, mitigation measures, and marine species monitoring and reporting efforts. Standard operating procedures are essential to maintaining safety and mission success, and in many cases have the added benefit of reducing potential environmental impacts. Mitigation measures are designed to reduce or avoid potential impacts on marine resources. Marine species monitoring efforts are designed to track compliance with take authorizations, evaluate the effectiveness of mitigation measures, and improve understanding of the impacts of training and testing activities on marine resources within the Northwest Training and Testing (NWTT) Study Area (Study Area).

This chapter also includes mitigation measures proposed for live-fire gunnery exercise training activities conducted by the U.S. Coast Guard (USCG) in the Offshore Area. The Navy and USCG conduct gunnery exercise training similarly and propose to apply the same mitigation measures for those activities.

5.1 STANDARD OPERATING PROCEDURES

Effective training, maintenance, research, development, testing, and evaluation (hereafter referred to collectively as the Proposed Action) require that participants utilize their sensors and weapon systems to their optimum capabilities as required by the activity objectives. The Navy currently employs standard practices to provide for the safety of personnel and equipment, including vessels and aircraft, as well as the success of the training and testing activities. For the purpose of this document, standard practices are referred to as standard operating procedures. Because of their importance for maintaining safety and mission success, standard operating procedures have been considered as part of the Proposed Action under each alternative, and therefore are included in the Chapter 3 environmental analyses for each resource.

Navy standard operating procedures have been developed and refined over years of experience, and are broadcast via numerous naval instructions and manuals, including the following sources:

- Navy Range User's Manuals
- Ship, Submarine and Aircraft Safety Manuals
- Ship, Submarine and Aircraft Standard Operating Manuals
- Fleet Area Control and Surveillance Facility Range Operating Instructions
- Fleet Exercise Publications and Instructions
- Naval Sea Systems Command Test Range Safety and Standard Operating Instructions
- Navy Instrumented Range Operating Procedures
- Research, Development, Test and Evaluation Plans
- Naval Gunfire Safety Instructions
- Navy Planned Maintenance System Instructions and Requirements
- Federal Aviation Administration Regulations

In many cases there are incidental environmental, socioeconomic, and cultural benefits resulting from standard operating procedures. Standard operating procedures serve the primary purpose of providing for safety and mission success, and are implemented regardless of their secondary benefits. This is what distinguishes standard operating procedures, which are a component of the Proposed Action, from mitigation measures, which are designed entirely for the purpose of reducing environmental impacts

resulting from the Proposed Action. Because standard operating procedures are crucial to safety and mission success, the Navy will not modify them as a way to further reduce effects to environmental resources. Rather, mitigation measures will be used as the tool for avoiding and reducing potential environmental impacts. Standard operating procedures are internal documents and are under the configuration management of the individual commands. Standard operating procedures that are recognized as providing a potential secondary benefit are provided below.

5.1.1 General Safety

In the development of standard operating procedures and measures to protect the safety of its people, the Navy follows the guidance set forth in the Chief of Naval Operations Instructions (OPNAVINST) 5100.19 (Navy Safety and Occupational Health Program Manual for Forces Afloat) and 5100.23 (Navy Safety and Occupational Health Program Manual). These instructions provide minimum requirements under which organizations may develop procedures that delineate additional organizational specific requirements. These two instructions include policies for public safety; laser procedures; weapons firing procedures; and unmanned aircraft, surface, and underwater vehicle activities.

Unless otherwise noted, the following general procedures and practices are paralleled between the training community and the testing community. Some minor differences in terminology and requirements exist that tailor the procedure either for uniformed Navy personnel (training) or civilian science and technical personnel (testing). The same goals apply to both communities.

5.1.2 Vessel Safety

For the purposes of this chapter, the term ‘ship’ is inclusive of surface ships and surfaced submarines. The term ‘vessel’ is inclusive of ships and small boats (e.g., rigid-hull inflatable boats or commercially available boats used to support test operations).

Ships operated by or for the Navy have personnel assigned to stand watch at all times, day and night, when moving through the water (underway). Watch personnel undertake extensive training in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent, including on-the-job instruction and a formal Personal Qualification Standard Program (or equivalent program for supporting contractors or civilians), to certify that they have demonstrated all necessary skills (such as detection and reporting of floating or partially submerged objects). Watch personnel are composed of officers, enlisted men and women, and civilian equivalents. Their duties may be performed in conjunction with other job responsibilities, such as navigating the ship or supervising other personnel. While on watch, personnel employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent. After sunset and prior to sunrise, watch personnel employ night visual search techniques, which could include the use of night vision devices.

A primary duty of watch personnel is to detect and report all objects and disturbances sighted in the water that may be indicative of a threat to the ship and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per safety requirements, watch personnel also report any marine mammals sighted that have the potential to be in the direct path of the ship as a standard collision avoidance procedure. Because watch personnel are primarily posted for safety of navigation, range clearance, and man-overboard precautions, they are not normally posted while ships are moored to a pier. When anchored or moored to a buoy, a watch team is still maintained but with fewer personnel than when underway. When moored or at anchor, watch personnel may maintain security and safety of the ship by scanning the water for any indications of a threat (as described above).

While underway, Navy ships (with the exception of submarines) greater than 65 feet (ft.) (20 meters [m]) in length have at least two personnel standing watch; Navy ships less than 65 ft. (20 m) in length, submarines, and contractor vessels have at least one person standing watch. While underway, personnel standing watch are alert at all times and have access to binoculars. Due to limited manning and space limitations, small boats do not have dedicated personnel standing watch, and the boat crew is responsible for maintaining the safety of the boat and surrounding environment.

All vessels use appropriate caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

5.1.3 Aircraft Safety

Pilots of Navy aircraft make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike. The Department of Defense (DoD) continually implements and improves aviation safety programs in an effort to provide the safest flying conditions possible. One of these programs is the Bird/Wildlife Aircraft Strike Hazard prevention program. Throughout the military, air operations, aviation safety, and natural resources personnel work together to reduce the risk of bird and wildlife strikes through the Operational Risk Management process.

5.1.4 Laser Procedures

As described in Section 3.0.5.3.2.2, only low energy lasers, some of which could be hazardous to human eyes, are proposed for use. The following procedures are applicable to lasers of sufficient intensity to cause human eye damage.

5.1.4.1 Laser Operators

Only properly trained and authorized personnel operate lasers.

5.1.4.2 Laser Activity Clearance

Prior to commencing activities involving lasers, the operator ensures that the area is clear of unprotected or unauthorized personnel in the laser impact area by performing a personnel inspection or a flyover. The operator also ensures that any personnel within the area are aware of laser activities and are properly protected.

5.1.5 Weapons Firing Procedures

When the Navy conducts any potentially hazardous training or testing activity, such as weapons firing, personnel are assigned to fulfill critical safety functions. A Range Safety Officer is responsible for the safe conduct of all activities on the range on which activities are being conducted. For activities conducted off of designated ranges, an officer (or civilian equivalent) on a ship or aircraft engaged in the activity or within visual range of the activity may function as the Range Safety Officer. For larger exercises, the Officer Conducting the Exercise (or civilian equivalent) is ultimately responsible for the safe conduct of range training. Either the Officer Conducting the Exercise or the Range Safety Officer assigned to the event can terminate activities if unsafe conditions exist.

5.1.5.1 Notice to Mariners

A Notice to Mariners (NTM) is routinely issued in advance of missile firing activities or explosive bombing activities. For activities involving gunnery, the Navy evaluates the need to publish a NTM based on the

scale, location, and timing of the activity. More information on the NTM is found in Chapter 3, Section 3.13 (Public Health and Safety).

5.1.5.2 Weapons Firing Range Clearance

The weapons firing hazard range must be clear of non-participating vessels and aircraft before firing activities will commence. The size of the firing hazard range is based on the farthest firing range capability of the weapon being used. All missile and rocket firing activities are carefully planned in advance and conducted under strict procedures that place the ultimate responsibility for range safety on the officer conducting the exercise or civilian equivalent. All weapons firing is secured when cease fire orders are received from the Range Safety Officer or when the line of fire is endangering any object other than the designated target.

Pilots of Navy aircraft are not authorized to expend ordnance, fire missiles, or drop other airborne devices through any cloud cover where visual clearance of the air and surface area is not possible. The two exceptions to this requirement are: (1) when operating in the open ocean, air, and surface clearance through visual means or radar surveillance is acceptable; and (2) when the officer conducting the exercise accepts responsibility for the safeguarding of airborne and surface traffic.

During activities that involve recoverable targets, (e.g., aerial drones), the Navy recovers the target and any associated parachutes to the maximum extent practicable consistent with operational requirements and personnel safety.

5.1.6 Swimmer Defense Testing Procedures

A daily in situ calibration of the source levels is used to establish a clearance area to the 145 decibels (dB) referenced to (re) 1 micropascal (µPa) sound pressure level threshold for non-participant personnel safety. A hydrophone is stationed during the calibration sequences in order to confirm the clearance area. Small boats patrol the 145 dB re 1 µPa sound pressure level area during all test activities. Boat crews are equipped with binoculars and remain vigilant for non-participant divers and boats, swimmers, snorkelers, and dive flags. If a non-participating swimmer, snorkeler, or diver is observed entering into the area of the swimmer defense system, the power levels of the defense system are reduced. An additional 100-yard (yd.) (90 m) buffer is applied to the initial sighting location of the non-participant as an additional precaution. If the area cannot be maintained free of non-participating swimmers, snorkelers, and divers, testing will cease until the non-participant has moved outside the area.

5.1.7 Unmanned Aircraft System Procedures

Procedures for the use of unmanned aircraft systems in the Study Area are published in the Pacific Northwest Operations Area Manual (U.S. Department of the Navy 2012).

5.1.8 Unmanned Surface Vehicle and Unmanned Underwater Vehicle Procedures

Standard safety requirements and operational restrictions apply for all types of unmanned underwater vehicles (UUVs) during training and testing activities including, but not limited to, torpedoes, mobile anti-submarine warfare (ASW) targets, inert mines, and research and development vehicles.

5.1.9 Towed In-Water Device Procedures

Prior to deploying a towed device from a manned platform, there is a standard operating procedure to search the intended path of the device for any floating debris (e.g., driftwood) or other potential obstructions (e.g., animals), since they have the potential to cause damage to the device.

5.1.10 Best Management Practices

Best management practices include measures that regulate operations to ensure compliance with pollution emission requirements and general resource conservation goals. In the development of best management practices, the Navy will utilize and implement all applicable sections of OPNAVINST 5090.1C Change 1 (Environmental Readiness Program Manual). This instruction provides minimum requirements, under which organizations may develop procedures that delineate additional organizational specific requirements. Some standard operating procedures also provide best management practices value.

In Chapter 3 of this Environmental Impact Statement (EIS)/Overseas EIS (OEIS), the Navy analyzed environmental resources for potential impacts resulting from the Navy's Proposed Action. All of the Navy's best management practices provide protection to environmental resources. For example, Navy policies and procedures identified in Navy instructions such as the Environmental Readiness Program Manual, include directives regarding waste management, pollution prevention, and recycling, all of which benefit sediments and water quality in the ocean. Any procedures or practices that benefit ocean sediments and water quality in turn benefit all marine life in the ocean, from plants and invertebrates, to fish and marine mammals.

Some examples of standard operating procedures that also contribute to best management practices are pollution control programs. The Navy's compliance with the Clean Air Act and its implementing regulations has resulted in comprehensive air quality management programs, helping to ensure minimum impacts to air quality.

Many of the Navy's standard operating procedures are directed at enhancing safety, both for the Sailors involved in the activities as well as non-participant members of the public. As an example, the Navy's Bird/Wildlife Aircraft Strike Hazard prevention program was intended as a safety procedure and has the added benefit of reducing bird injuries and fatalities. This program has resulted in reduced incidents of aircraft striking birds.

These examples illustrate common Navy procedures and practices that can often reduce impacts to environmental and human resources. The following section will describe procedures implemented specifically to mitigate environmental impacts.

5.2 Introduction to Mitigation

The Navy recognizes that the Proposed Action has the potential to impact the environment. Mitigation measures are modifications to the Proposed Action that are implemented for the sole purpose of reducing a specific potential environmental impact on a particular resource. The procedures discussed in this chapter, most of which are currently or were previously implemented as a result of past environmental compliance documents, Endangered Species Act (ESA) biological opinions, Marine Mammal Protection Act (MMPA) Letters of Authorization, or other formal or informal consultations with regulatory agencies, are being coordinated with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) through the consultation and permitting process.

In order to make the findings necessary to issue an MMPA letter of authorization, it may be necessary for NMFS to require additional mitigation measures or monitoring beyond those contained in this Draft EIS/OEIS. These could include measures considered, but eliminated in this EIS/OEIS, or as yet undeveloped measures. The public will have an opportunity to provide information to NMFS through the MMPA process, both during the comment period following NMFS' notice of receipt of the

application for a letter of authorization, and during the comment period following publication of the proposed rule. NMFS may propose additional mitigation measures or monitoring in the proposed rule.

Additionally, the Navy is engaging in consultation processes under the ESA with regard to listed species that may be affected by the Proposed Action described in this EIS/OEIS. For the purposes of the ESA Section 7 consultation, the mitigation measures proposed here may be considered by NMFS or USFWS as beneficial actions taken by the Federal agency or applicant (50 Code of Federal Regulations 402.14(g)(8)). If required to satisfy requirements of the ESA, NMFS or USFWS may develop an additional set of measures contained in terms and conditions, reasonable and prudent measures, or conservation recommendations in any biological opinion issued for the Proposed Action. The Navy will also consider public comments on proposed mitigation measures described in this Draft EIS/OEIS.

5.2.1 Regulatory Requirements for Mitigation

An EIS must analyze the affected environment, discuss the environmental impacts of the Proposed Action and each alternative, and assess the significance of the impacts to the environment. Mitigation measures are designed to help reduce the severity or intensity of impacts of the Proposed Action and can occur early in the planning process. An agency may choose not to take the action or to move the location of the action. Mitigation measure development also occurs throughout the analysis process whenever an impact is minimized by limiting the degree or magnitude of the action or its implementation. Mitigation measures can also include actions that repair, rehabilitate, or restore the affected environment or reduce impacts over time through constant monitoring and corrective adjustments.

In accordance with the National Environmental Policy Act (NEPA) requirement, the environmental benefit of all Navy recommended proposed mitigation measures will apply to all alternatives analyzed in this EIS, and according to Navy policy, will also apply to the OEIS where applicable and appropriate. Additionally, the White House Council on Environmental Quality (CEQ) issued guidance for mitigation and monitoring on 14 January 2011. This guidance affirms that federal agencies, including the Navy, should:

- commit to mitigation in decision documents when they have based environmental analysis upon such mitigation (by including appropriate conditions on grants, permits, or other agency approvals, and making funding or approvals for implementing the Proposed Action contingent on implementation of the mitigation commitments);
- monitor the implementation and effectiveness of mitigation commitments;
- make information on mitigation and monitoring available to the public, preferably through agency web sites; and
- remedy ineffective mitigation when the federal action is not yet complete.

The CEQ guidance encourages federal agencies to develop internal processes for post-decision monitoring to ensure the implementation and effectiveness of the mitigation. It also states that federal agencies may use adaptive management as part of an agency's action. Adaptive management, when included in the NEPA analysis, allows for the agency to take alternate mitigation actions if mitigation commitments originally made in the planning and decision documents fail to achieve projected environmental outcomes. Adaptive management generally involves four phases: plan, act, monitor, and evaluate. This process allows the use of the results to update knowledge and adjust future management actions accordingly. Through implementing mitigation measures from the Navy's previous planning,

consultations, permits, and monitoring of those efforts, the Navy has collected data to further refine proposed mitigation measures.

Through the planning, consultation, and permitting processes, federal regulatory agencies may also suggest that the Navy analyze additional mitigation measures for inclusion in Final EIS/OEISs and associated consultation and permitting documents. Any proposals for additional mitigation measures should be based on the federal agency's assessment of the likelihood that such measures will contribute to a notable reduction of the environmental impact. If additional measures are identified, the Navy will apply the effectiveness and operational assessment protocol discussed in Section 5.3 (Mitigation Assessment) to determine whether the additional measure will be proposed for implementation. This additional analysis will be presented in the Final EIS/OEIS, and, the final suite of mitigations resulting from the ongoing planning, consultation, and permitting processes will be documented in the Record of Decision (ROD).

5.2.2 Overview of Mitigation Approach

This section describes the approach that the Navy took to develop its recommended mitigation measures. The Navy's overall approach to assessing potential mitigation measures was based on two principles: (1) mitigations will be effective at reducing potential impacts on the resource; and (2) from a military perspective, the mitigations are practical to implement, executable, and personnel safety and readiness will not be impacted. The assessment process involved using information directly from Chapter 3 (Affected Environment and Environmental Consequences) and assessing all existing mitigation and proposals for new or modified mitigation in order to determine if recommending a mitigation measure for implementation would be appropriate.

This document organized, and where appropriate, analyzed training and testing activities separately. This separation was needed because the training and testing communities perform activities for differing purposes, and in some cases, with different personnel and in different locations. For example, there is a fundamental difference between the testing of a new antisubmarine warfare system with civilian scientists and engineers, and the eventual training of sailors and aviators with that same system. As such, mitigations that the Navy recommends for both training and testing activities are presented together, while mitigations that are designed for and executable only by the training or testing community are presented separately based on location.

5.2.2.1 Lessons Learned from Previous Environmental Impact Statements/Overseas Environmental Impact Statements

In an effort to improve upon past processes, the Navy considered all mitigations previously implemented and adapted its mitigation assessment approach based on lessons learned from previous EISs, ESA biological opinions, MMPA Letters of Authorization, and other formal or informal consultations with regulatory agencies. For example, during the development of the Northwest Training Range Complex EIS/OEIS the Navy determined that relocation of activities to another range complex was not possible due to a number of factors. The Navy considered reduction or elimination of training in the Northwest Training Range Complex, but determined that the amount and cost of travel to other range complexes to fulfill training requirements would result in an unacceptable increase in time away from the homeport. While some Pacific-Northwest-based units do travel to other ranges for certain training activities, all units must continue to train locally for most routine activities.

Navy planners, scientists, and the operational community assessed the effectiveness of a full suite of potential mitigation measures (a portion of which were specific mitigation areas) on a case-by-case

basis, using information and lessons learned from the Navy's internal adaptive management process. The resulting assemblage of recommended measures is comprised of currently implemented measures, modifications of currently implemented measures, and newly proposed measures. Details on the assessment methods are provided in Section 5.2.3 (Assessment Method). The rationale for recommending, modifying, adding, or discontinuing each measure is provided in Section 5.3 (Mitigation Assessment).

5.2.2.2 Protective Measures Assessment Protocol

The Protective Measures Assessment Protocol is a decision support and situational awareness software tool that the Navy uses to facilitate compliance with mitigation measures during the conduct of certain training and testing activities at sea. The Navy runs the Protective Measures Assessment Protocol program during the event planning process to ensure that personnel involved in the activity are aware of the mitigation requirements and to help ensure that all mitigations are implemented appropriately. In addition to providing notification of the requirement mitigation, the tool also provides a visual display of the exercise area, unit's position in relation to the target area, and any relevant environmental data. The final suite of mitigation measures contained in the ROD will be integrated into the Protective Measures Assessment Protocol.

Section 5.3.1.1.1.1 (United States Navy Afloat Environmental Compliance Training Series) contains information about the newly developed Protective Measures Assessment Protocol training module.

5.2.3 Assessment Method

As shown in Figure 5.2-1, the Navy undertook an effectiveness assessment and operational assessment for each potential mitigation measure to ensure its compatibility with Section 5.2.2 (Overview of Mitigation Approach). The Navy used information from published and readily available sources, as well as Navy after-action and monitoring reports. When available, these data were used when they represented the best available science and if they were generally accepted by the scientific community, to ensure that they were applicable and contributed to the analysis.

5.2.3.1 Effectiveness Assessment

5.2.3.1.1 Procedural Measures

Procedural measures could involve employing techniques or technology to modify an activity in order to avoid or reduce a potential impact on a particular resource. For the purposes of organization, procedural measures are discussed within two subcategories: Lookouts and mitigation zones.

A procedural measure was deemed effective if implementing the measure was likely to result in avoidance or reduction of an impact on a resource. The level of avoidance or reduction of the impact gained from implementing a procedural measure was weighed against the potential for a shift in impacts resulting from the activity modification. For example, if predictive modeling results indicate that the use of underwater explosives could cause unacceptable impacts on a particular resource, those impacts could possibly be reduced by substituting non-explosive activities for explosive activities. However, if the increased use of non-explosive activities would consequently produce an unacceptable impact on habitats due to an associated physical disturbance or strike risk from military expended materials, the measure would not necessarily be justifiable.

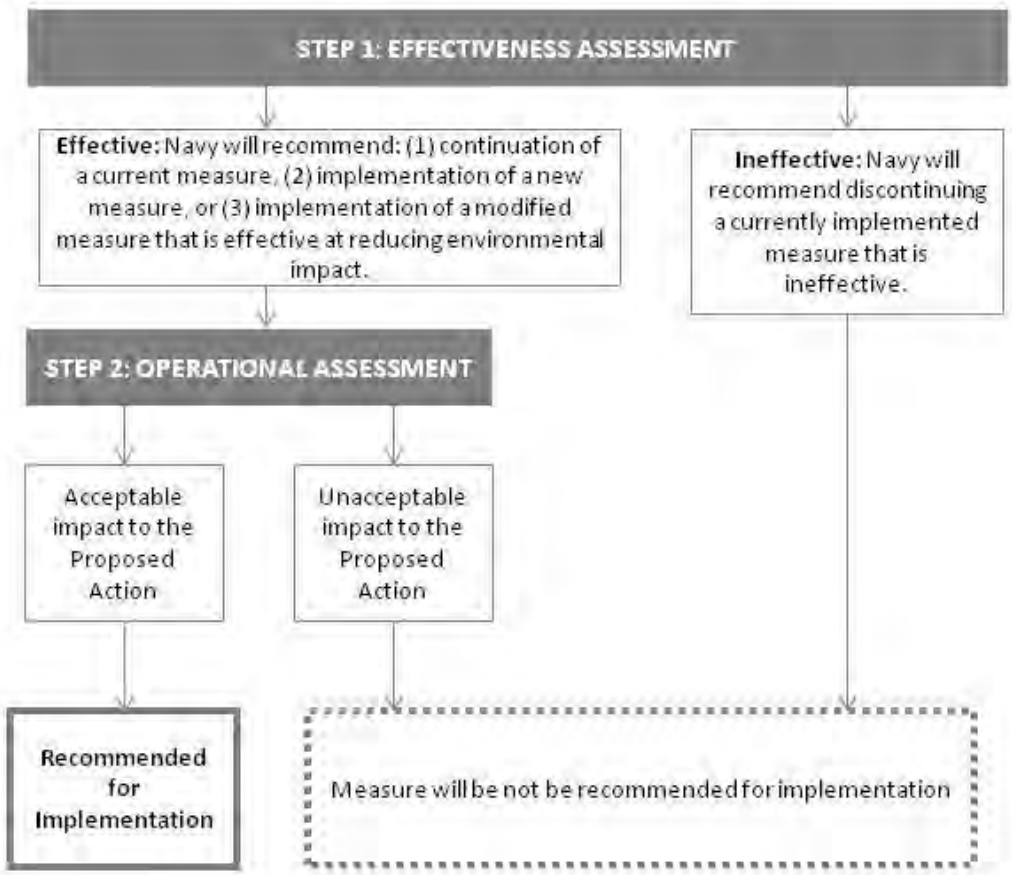

Figure 5.2-1: Flowchart of Process for Determining Proposed Mitigation Measures

A procedural measure was deemed ineffective if its implementation would not result in avoidance or reduction of an impact on a resource, or if an unacceptable impact will simply be shifted from one resource to another. For ineffective procedural measures that are currently being implemented, the rationale for terminating, modifying, or continuing to carry out the measure is included in the discussion.

5.2.3.1.2 Proposed Mitigation Areas

In order to avoid or reduce a potential impact on a particular resource, the Navy would either limit the time of day or duration in which a particular activity could take place, or move or relocate a particular activity outside of a specific geographic area, yet still within the Study Area. Within mitigation areas, the measures would only apply to the specific activity that resulted in the requirement for mitigation, and would not prevent or restrict other activities from occurring during that time or in that area.

A proposed mitigation area was deemed effective if implementing the measure may be likely to result in avoidance or reduction of the impact on the resource. The specific season, time of day, or geographic area must be important to the resource. In determining importance, special consideration was given to time periods or geographic areas having characteristics such as especially high overall density or percent population use, seasonal bottlenecks for a migration corridor, and identifiable key foraging and reproduction areas.

Avoidance or reduction of the impact in the specific time period or geographic area was weighed against the potential for causing new impacts in alternative time periods or geographic areas. For example, if the proposed training or test event predicted to cause unacceptable impacts to a particular resource in a known foraging location, those impacts could possibly be reduced by relocating those activities to a new location. However, if the proposed training or test event at the new location would consequently produce an unacceptable impact to the same or a different resource at the new location, the measure would not necessarily be justifiable.

A proposed mitigation area was deemed ineffective if implementing the measure would not result in avoidance or reduction of an impact to a resource, or if an unacceptable impact would simply be shifted from one time period or location to another. For ineffective mitigation areas that are currently being implemented, the rationale for terminating, modifying, or continuing to carry out the measure is included in the discussion.

5.2.3.2 Operational Assessment

The Navy conducted the operational assessment for procedural measures and proposed mitigation areas using the criteria described below. The Navy deemed procedural and mitigation area measures to have acceptable operational impacts to a particular proposed activity if the following conclusions were reached:

1. Implementation of the measure will not increase safety risks to Navy personnel and equipment.

2. Implementation of the measure is practical. Practicality was defined by the following factors:
    - The measure does not result in an unacceptable increase in resource requirements (e.g., wear and tear on equipment, additional fuel, additional personnel, increased training or testing requirements, or additional reporting requirements).
    - The measure does not result in an unacceptable increase in time away from homeport for Navy personnel.
    - The measure does not result in national security concerns. Should national security require conducting more than the designated number of activities, or a change in how the Navy conducts those activities, the Navy reserves the right to provide the regulatory federal agency with prior notification and include the information in any associated exercise or monitoring reports.
    - The measure is consistent with Navy policy.

3. Implementation of the measure will not result in an unacceptable impact on readiness. A primary factor that was considered for all mitigation measures is that the measure must not modify the activity in a way that no longer allows the activity to meet the intended objectives, and ultimately must not interfere with the Navy meeting all of its military readiness requirements. Specifically, for mitigation area measures, the following additional factors were considered:
    - The activity is not dependent on a specific range or range support structure within the mitigation area, and there are alternate areas with the necessary environmental conditions (e.g., oceanographic conditions).
    - The mitigation area does not hold any current or foreseeable future readiness value. This assessment will be revisited if Navy operations or national security interests conclude that training or testing needs to occur within the mitigation area.

- Implementation of the measure will not prohibit conducting shipboard maintenance, repair, and testing pierside prior to at-sea operations.

4. The Navy has legal authority to implement the measure.

If all four of the above conditions were not able to be reached, the Navy deemed the procedural or proposed mitigation area measure to have unacceptable impacts on the Proposed Action, and did not recommend those unacceptable measures for implementation.

5.3 MITIGATION ASSESSMENT

The effectiveness and operational assessments resulted in potential mitigation measures being organized into the following four sections:

- Section 5.3.1 (Lookout Procedural Measures) includes recommended measures specific to the use of Lookouts or trained marine species observers.
- Section 5.3.2 (Mitigation Zone Procedural Measures) includes recommended measures specific to visual observations with a mitigation zone.
- Section 5.3.3 (Mitigation Areas) includes recommended measures specific to particular locations.
- Section 5.3.4 (Mitigation Measures Considered but Eliminated) includes measures that the Navy does not recommend for implementation due to the measure being ineffective at reducing environmental impacts, having an unacceptable operational impact, or being incompatible with Section 5.2.2 (Overview of Mitigation Approach).

A summary of the Navy recommended measures is provided in Table 5.4-1.

5.3.1 LOOKOUT PROCEDURAL MEASURES

As described in Section 5.1 (Standard Operating Procedures), ships have personnel assigned to stand watch at all times while underway. Standard watch personnel may perform watch duties in conjunction with job responsibilities that extend beyond looking at the water or air (such as supervision of other personnel). This section will introduce Lookouts, who perform similar duties to standard personnel standing watch and whose duties satisfy safety of navigation and mitigation requirements.

The Navy will have two types of Lookouts for the purposes of conducting visual observations: those positioned on ships; and those positioned ashore, in aircraft, or on small boats. Lookouts positioned on ships will diligently observe the air and surface of the water. They will have multiple observation objectives, which include but are not limited to detecting the presence of biological resources and recreational or fishing boats, observing the mitigation zones described in Section 5.3.1.2 (Lookouts), and monitoring for vessel and personnel safety concerns.

Due to manning and space restrictions on aircraft, small boats, and some Navy ships, Lookouts for these platforms may be supplemented by the aircraft crew or pilot, boat crew, range site personnel, or shore-side personnel. Lookouts positioned in minimally manned platforms may be responsible for tasks in addition to observing the air or surface of the water (e.g., navigation of a helicopter or small boat). However, all Lookouts will, considering personnel safety, practicality of implementation, and impact on the effectiveness of the activity, comply with the observation objectives described above for Lookouts positioned on ships.

Some testing activities are conducted close enough to shore that observers located at shore sites have a clear view of the activities as they are conducted, and benefit from advanced systems (improved optics, acoustic detection) available for detection of animals. The procedural measures described below primarily consist of having Lookouts during specific training and testing activities.

5.3.1.1 Specialized Training

5.3.1.1.1 Training for Navy Personnel and Civilian Equivalents

5.3.1.1.1.1 United States Navy Afloat Environmental Compliance Training Series

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to continue implementing the Marine Species Awareness Training for watch personnel and Lookouts, and to add the requirement for additional Navy personnel and civilian equivalents to complete one or more environmental training modules.

The Navy has developed the United States Navy Afloat Environmental Compliance Training Series to help ensure Navy-wide compliance with environmental requirements, and to help Navy personnel gain a better understanding of their personal roles and responsibilities. The training series contains four interactive multimedia training modules. Personnel will be required to complete all modules identified in their career path training plan.

The first module is the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series. The introduction module provides information on environmental laws (e.g., ESA and MMPA) and responsibilities relevant to Navy training and testing activities. The material is put into context of why environmental compliance is important to the Navy, from the most junior sailor to Commanding Officers.

The second module is the U.S. Navy Marine Species Awareness Training. Consistent with current requirements, all personnel standing watch on the bridge, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare helicopter crews, civilian equivalents, and Lookouts will successfully complete the Marine Species Awareness Training prior to standing watch or serving as a Lookout. The module contained within the U.S. Navy Environmental Compliance Training Series is an update to the current Marine Species Awareness Training version 3.1. The updated training is designed to improve the effectiveness of visual observations for marine resources, including marine mammals and sea turtles. The Marine Species Awareness Training provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures.

The third module is on the U.S. Navy Protective Measures Assessment Protocol. Protective Measures Assessment Protocol is a decision support and situational awareness software tool that the Navy uses to facilitate compliance with worldwide mitigation measures during the conduct of training and testing activities at sea. The module provides instruction for generating and reviewing Protective Measures Assessment Protocol reports. Section 5.2.2.2 (Protective Measures Assessment Protocol) contains additional information on the benefits of the software tool.

The fourth module is on the U.S. Navy Sonar Positional Reporting System and marine mammal incident reporting. The Navy developed the Sonar Positional Reporting System as its official record of underwater sound sources used under its MMPA permits. Marine mammal incidents include vessel strikes and animal strandings. The module provides instruction on the reporting requirements and procedures.

Similarly, USCG personnel engaged as Lookouts for the purposes of mitigation described below must complete the USCG's Wildlife Observer Identification training.

Effectiveness and Operational Assessment

Navy personnel undergo extensive training in order to stand watch on the bridge. Standard training includes on-the-job instruction under the supervision of experienced personnel, followed by completion of the Personal Qualification Standard program. The Personal Qualification Standard program certifies that personnel have demonstrated the skills needed to stand watch, such as detecting and reporting floating or partially submerged objects.

The United States Navy Afloat Environmental Compliance Training Series, including the updated Marine Species Awareness Training, is a specialized multimedia training program designed to help Navy operational and test communities best avoid potentially harmful interactions with marine species. The program provides training on how to sight marine species, focusing on marine mammals. The training also includes instruction for visually identifying sea turtles, concentrations of floating vegetation (kelp paddies), jellyfish aggregations, and flocks of seabirds, which are often indicators of marine mammal or sea turtle presence. The Marine Species Awareness Training also addresses the role that watchstanders and Lookouts play in helping the Navy maintain compliance with environmental protection requirements, as well as supporting Navy stewardship commitments.

In summary, the Navy believes that the U.S. Navy Afloat Environmental Compliance Training Series, including the updated Marine Species Awareness Training, is the best and most appropriate forum for teaching watch personnel and Lookouts about their responsibilities for helping reduce impacts on the marine environment. The Marine Species Awareness Training provides the Navy with invaluable training for a relatively large number of personnel. Constantly shifting personnel assignments presents a real challenge; however, the format and structure of the U.S. Navy Afloat Environmental Compliance Training Series will help the Navy reduce costs during fiscally constrained periods and provide constant access to training. Overall, the Marine Species Awareness Training is an effective tool for improving the potential for Lookouts to detect marine species while on duty.

Implementation of the Marine Species Awareness Training is considered to be an acceptable program with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.1.2 Lookouts

The Navy proposes to use one or more Lookouts during the training and testing activities described below, which are organized by stressor category. A comparison of the currently implemented mitigation measures and recommended mitigation measures are provided where applicable. The effectiveness and operational assessments are discussed for all Lookout measures collectively in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts) and Section 5.3.1.2.6 (Operational Assessment for Lookouts).

5.3.1.2.1 Acoustic Stressors – Non-Impulse Sound

5.3.1.2.1.1 Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar

Under the Proposed Action, low-frequency active sonar would be used only during testing activities conducted in the Offshore Area and in the Inland Waters of the Study Area, and not during any proposed training activities. Therefore, mitigation measures for low-frequency active sonar sources currently exist only for these testing activities.

Training

The Navy's current Lookout mitigation measures during training activities involving hull-mounted mid-frequency active sonar include requirements such as the number of personnel on watch and the manner in which personnel are to visually search the area in the vicinity of the ongoing activity.

The Navy is proposing to maintain the number of Lookouts currently implemented for ships using hull-mounted mid-frequency active sonar. Ships using hull-mounted mid-frequency active sonar sources associated with ASW and mine warfare activities at sea (with the exception of ships less than 65 ft. [20 m] in length, which are minimally manned) will have two Lookouts at the forward position. For the purposes of this document, low-frequency active sonar does not include surface towed array surveillance system low frequency active sonar, which is not a part of this Proposed Action.

While using hull-mounted mid-frequency active sonar sources underway, vessels less than 65 ft. in length, and ships that are minimally manned will have one Lookout at the forward position due to space and manning restrictions.

Ships conducting active sonar activities while moored or at anchor (including pierside testing or maintenance) will maintain one Lookout.

Testing

There are no current mitigation measures for hull-mounted mid-frequency sonar testing activities in the Study Area. The Navy's current Lookout mitigation measures during low-frequency sonar testing activities are:

- Vessels on a range shall use Lookouts during all hours of range activities. Lookout duties include looking for marine mammals. All sightings of marine mammals shall be reported to the Range Officer in charge of overseeing the activity.
- Visual surveillance shall be conducted just prior to all in-water exercises. Surveillance shall include, as a minimum, monitoring from all participating surface craft and, where available, adjacent shore sites.
- When cetaceans have been sighted in the vicinity of the operation, all range participants increase vigilance and take reasonable and practicable actions to avoid collisions and activities that may result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction, subject to environmental and other conditions (e.g., safety, weather).

The Navy's Proposed Action includes newly assessed hull-mounted mid-frequency active sonar testing activities as well as low-frequency active sonar testing. The Navy proposes to apply the existing testing mitigation measures to both low-frequency and hull-mounted mid-frequency testing. Any appropriately trained member of the test support staff may serve as a Lookout at any time during an event so long as the observation and reporting is carried out as identified in existing measures. Testing conducted at sea on a maximally manned vessel over 65 ft. will employ two Lookouts. Testing conducted pierside or shore-based testing will employ one Lookout. Testing conducted from small boats, minimally manned vessels, or aircraft will employ one Lookout.

5.3.1.2.1.2 High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar

Training

The Navy currently conducts high-frequency and non-hull-mounted mid-frequency active sonar training in the Study Area. Non-hull-mounted mid-frequency active sonar training activities include the use of aircraft deployed sonobuoys and helicopter dipping sonar. During those activities, the Navy employs the following mitigation measure regarding Lookout procedures:

- Navy aircraft participating in exercises at sea shall conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.
- Helicopters shall observe/survey the vicinity of an ASW training event for 10 minutes before the first deployment of active (dipping) sonar in the water.

The Navy is proposing to continue using the number of Lookouts currently implemented for aircraft conducting non-hull-mounted mid-frequency active sonar activities.

Mitigation measures do not currently exist for other high-frequency active sonar activities associated with ASW and mine warfare training, or for new platforms; therefore, the Navy is proposing to add a new measure for these activities and on these platforms when conducted in the Study Area. The recommended measure is provided below.

The Navy will have one Lookout on ships or aircraft conducting high-frequency or non-hull-mounted mid-frequency active sonar activities associated with ASW and mine warfare activities at sea.

Testing

The Navy currently conducts high-frequency and non-hull-mounted mid-frequency active sonar testing activities in the Study Area. These activities include the use of aircraft deployed sonobuoys, countermeasure testing, unmanned vehicle testing, and non-explosive torpedo testing. Mitigation measures for high-frequency active sonar sources currently exist only for some NAVSEA testing activities conducted in the Offshore Area and Inland Waters of the Study Area. These mitigation measures are the same as described above for testing in Section 5.3.1.2.1.1 (Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar). The Navy is proposing to apply the same Lookout requirements to all NAVSEA testing activities in the Proposed Action.

The Navy's proposed mitigation measures for Naval Air Systems Command testing activities are consistent with Navy training mitigation measures described above.

5.3.1.2.2 Acoustic Stressors – Explosives and Impulse Sound

5.3.1.2.2.1 Improved Extended Echo Ranging Sonobuoys

Training

The Navy is proposing to continue the Lookout procedural measures currently implemented for this activity and to clarify that one Lookout is required:

- Crews shall conduct visual reconnaissance of the drop area prior to laying their intended sonobuoy pattern. This search shall be conducted at an altitude below 1,500 ft. (460 m) at a slow speed, if operationally feasible and weather conditions permit. In dual aircraft operations, crews are allowed to conduct area clearances utilizing more than one aircraft.

- Crews shall conduct a minimum of 30 minutes of visual and aural monitoring of the search area prior to commanding the first post detonation. This 30-minute observation period may include pattern deployment time.
- When operationally feasible, Navy crews shall conduct continuous visual and aural monitoring of marine mammal activity. This shall include monitoring of aircraft sensors from the time of the first sensor placement until the aircraft have left the area and are out of range of these sensors.
- Aural Detection – If the presence of marine mammals is detected aurally, then that shall cue the Navy aircrew to increase the vigilance of their visual surveillance. Subsequently, if no marine mammals are visually detected, then the crew may continue multi-static active search.
- Mammal monitoring shall continue until out of own-aircraft sensor range.

Testing

The Navy's current and proposed mitigation measures for testing activities are consistent with Navy training mitigation measures described above.

5.3.1.2.2.2 Explosive Signal Underwater Sound Buoys Using 0.6–2.5 Pound Net Explosive Weight

Lookout measures do not currently exist for explosive Signal Underwater Sound (SUS) buoy exercises using 0.6–2.5 pound (lb.) net explosive weight.

Training

The Navy is proposing to add this measure. Aircraft conducting explosive sonobuoy exercises using 0.6–2.5 lb. net explosive weight will have one Lookout.

Testing

The Navy's proposed mitigation measures for testing activities are consistent with Navy training mitigation measures described above.

5.3.1.2.2.3 Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices

Training

Mine countermeasure and neutralization activities in the Study Area involve the use of diver-placed charges that typically occur close to shore. When these activities are conducted using a positive control firing device, the detonation is controlled by the personnel conducting the activity and is not authorized until the area is clear at the time of detonation. When detonations are not controlled using a positive control firing device they are categorized as time-delay firing devices and are covered in Section 5.3.1.2.2.4 (Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices).

Currently, the Navy employs the following Lookout procedures during mine countermeasure and neutralization activities using positive control firing devices:

- Two survey boats will be used to conduct seabird and marine mammal surveys within a 700 yd. (640 m) radius of 2.5 lb. (1.1 kilograms [kg]) net explosive weight training activities, within a 330 yd. (300 m) radius for the 1.5 lb. (0.7 kg) net explosive weight training charge, and within a 110 yd. (100 m) radius for a 1-ounce (31-gram) net explosive weight charge.
- Transect lines will be no more than 110 yd. (100 m) apart and beginning at the outside radius.
- Pre-exercise surveys shall be conducted within 30 minutes prior to commencement of the scheduled explosive event.

- The two survey boats will approach from the opposite direction and move toward the center (or explosive charge placement area) and work their way to the outside of the radius.
- Survey boats will maintain speed equal to or less than 10 knots.
- Each boat will have a minimum of two surveyors using aid of binoculars (not including the boat operator).
- In case of fog or reduced visibility, the surveyors must be able to see a minimum of 55 yd. (50 m) or the training event cannot be conducted.
- The above protocol will be reduced to one boat for the 1-ounce (31-gram) net explosive weight charge.

The Navy is proposing to continue using the Lookout procedures currently implemented for mine neutralization activities involving positive control diver placed charges using up to a 2.5 lb. net explosive weight. The Navy is proposing that activities using up to a 2.5 lb. net explosive weight (bin E3) detonation will have a total of four Lookouts (two Lookouts positioned in each of the two support vessels). All divers placing the charges on mines will support the Lookouts while performing their regular duties. The divers and Lookouts will report all marine mammal, sea turtle, and marbled murrelet sightings to their dive support vessel.

Testing

The Navy's Proposed Action does not include mine countermeasure and neutralization testing activities.

5.3.1.2.2.4 Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices

Training

As background, when mine neutralization activities using diver-placed charges (up to a 2.5 lb. net explosive weight) are conducted with a time-delay firing device, the detonation is fused with a specified time-delay by the personnel conducting the activity and is not authorized until the area is clear at the time the fuse is initiated. During these activities, the detonation cannot be terminated once the fuse is initiated due to human safety concerns.

The Navy's current Lookout procedures during mine countermeasure and neutralization activities using diver-placed time-delay firing devices are the same as described in Section 5.3.1.2.2.3 (Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices).

The Navy is proposing to continue using the Lookout procedures currently implemented for mine neutralization activities involving diver-placed time-delay firing devices using up to a 2.5 lb. net explosive weight. The Navy is proposing that activities using up to a 2.5 lb. net explosive weight (bin E3) detonation will have a total of four Lookouts (two Lookouts positioned in each of the two support vessels). All divers placing the charges on mines will support the Lookouts while performing their regular duties. The divers and Lookouts will report all marine mammal, sea turtle, and marbled murrelet sightings to their dive support vessel.

Testing

The Navy's Proposed Action does not include mine neutralization testing activities.

5.3.1.2.2.5 Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target

Training

Currently, the Navy and USCG each employ the following Lookout procedures during gunnery exercises:

- From the intended firing position, trained Lookouts shall survey the mitigation zone for marine mammals prior to commencement and during the exercise as long as practicable.
- If applicable, target towing vessels shall maintain a Lookout. If a marine mammal is sighted in the vicinity of the exercise, the tow vessel shall immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

The Navy is proposing to continue using the Lookout procedures currently implemented for this activity. The Navy will have one Lookout on the vessel or aircraft conducting small-, medium-, or large-caliber gunnery exercises against a surface target. Towing vessels, if applicable, shall also maintain one Lookout.

Testing

The Navy's Proposed Action does not include gunnery testing activities.

5.3.1.2.2.6 Missile Exercises Using a Surface Target

Training

Currently, the Navy employs the following Lookout procedures during missile exercises:

- Aircraft shall visually survey the target area for marine mammals. Visual inspection of the target area shall be made by flying at 1,500 ft. (460 m) or lower, if safe to do so, and at slowest safe speed.
- Firing or range clearance aircraft must be able to actually see ordnance impact areas.

The Navy is proposing to continue using the Lookout procedures currently implemented for this activity. When aircraft are conducting missile exercises against a surface target, the Navy will have one Lookout positioned in an aircraft.

Testing

The Navy's Proposed Action does not include missile testing activities.

5.3.1.2.2.7 Bombing Exercises (Explosive)

Training

Currently, the Navy employs the following Lookout procedures during bombing exercises:

- If surface vessels are involved, Lookouts shall survey for floating kelp and marine mammals.
- Aircraft shall visually survey the target and buffer zone for marine mammals prior to and during the exercise. The survey of the impact area shall be made by flying at 1,500 ft. (460 m) or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

The Navy is proposing to (1) continue implementing the current measures for bombing exercises, and (2) clarify the number of Lookouts currently implemented for this activity. The Navy will have one Lookout positioned in an aircraft conducting bombing exercises, and trained Lookouts in any surface vessels involved.

Testing

The Navy's Proposed Action does not include bomb testing activities.

5.3.1.2.2.8 Torpedo (Explosive) Testing

The Navy currently has no Lookout procedures for this activity in the Study Area.

Training

The Navy does not include training with explosive torpedoes in the Proposed Action.

Testing

For explosive torpedoes tested from a surface ship, the Navy is proposing to use the Lookout procedures currently implemented for hull-mounted mid-frequency active sonar activities. For explosive torpedo tests from aircraft, the Navy will have one Lookout positioned in an aircraft.

5.3.1.2.2.9 Weapons Firing Noise During Gunnery Exercises

Training

The Navy and USCG are proposing to continue using the number of Lookouts currently implemented for gunnery exercises. The Navy will have one Lookout on the ship conducting explosive and non-explosive large-caliber gunnery exercises. This may be the same Lookout described in Section 5.3.1.2.2.5 (Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target) when that activity is conducted from a ship against a surface target.

Testing

The Navy's Proposed Action does not include gun testing activities.

5.3.1.2.2.10 Sinking Exercises

The Navy has historically conducted sinking exercises in the Study Area, and has completed environmental planning documents analyzing up to two sinking exercises per year. Because of this prior analysis, sinking exercises are included under the No Action Alternative, as part of the Navy's baseline of activities. However, sinking exercises are not proposed under Alternative 1 or Alternative 2.

5.3.1.2.3 Physical Disturbance and Strike

5.3.1.2.3.1 Vessels

Training

Currently, the Navy employs the following Lookout procedures to avoid physical disturbance and strike of marine mammals during at-sea training and testing:

- While underway, surface vessels shall have at least two Lookouts with binoculars; surfaced submarines shall have at least one Lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, Lookouts will watch for and report to the Officer of the Deck the presence of marine mammals.

The Navy is proposing to revise the mitigation measures for this activity as follows: while underway, vessels will have a minimum of one Lookout.

Testing

The Navy's current mitigation measures for testing activities are consistent with Navy training mitigation measures described above.

5.3.1.2.3.2 Towed In-Water Devices

The Navy currently has no Lookout procedures for this activity in the Study Area.

Training

The Navy is proposing to have one Lookout during activities using towed in-water devices when towed from a manned platform.

Testing

The Navy's proposed mitigation measures for testing activities from manned platforms are consistent with Navy training mitigation measures described above. During testing in which in-water devices are towed by unmanned platforms, a manned escort vessel will be included and one Lookout will be employed.

5.3.1.2.4 Non-Explosive Practice Munitions

5.3.1.2.4.1 Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target

Currently, the Navy and USCG employ the same mitigation measures for non-explosive gunnery exercises as described above in 5.3.1.2.2.5 (Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target).

Training

The Navy and USCG are proposing to continue using the number of Lookouts currently implemented for these activities. The Navy and USCG will have one Lookout during activities involving non-explosive practice munitions (e.g., small-, medium-, and large-caliber gunnery exercises) against a surface target.

Testing

The Navy's Proposed Action does not include gunnery testing activities.

5.3.1.2.4.2 Bombing Exercises

Currently, the Navy employs the same mitigation measures for non-explosive bombing exercises as described above in 5.3.1.2.2.7 (Bombing Exercises).

Training

The Navy is proposing to continue using the same Lookout procedures currently implemented for these activities. The Navy will have one Lookout positioned in an aircraft during non-explosive bombing exercises, and trained Lookouts in any surface vessels involved.

Testing

The Navy's Proposed Action does not include bomb testing activities.

5.3.1.2.5 Effectiveness Assessment for Lookouts

Personnel standing watch in accordance with Navy standard operating procedures have multiple job responsibilities. While on duty, these standard personnel standing watch often conduct marine species observation in addition to their primary job duties (e.g., aiding in the navigation of the vessel). By having one or more Lookouts observing the air and surface of the water during certain training and testing activities, the Navy increases the likelihood that marine species will be detected. It is also important to note that a number of training and testing activities involve multiple vessels and aircraft, thereby

increasing the cumulative number of Lookouts or watch personnel that could potentially be present during a given activity.

Although using Lookouts is expected to increase the likelihood that marine species will be detected at the surface of the water, it is unlikely that using Lookouts will be able to help avoid impacts to all species entirely due to the inherent limitations of visually detecting marine mammals. The probability of visually detecting a marine animal is dependent upon two things. An animal must be present in an area to be seen (known as the availability bias), and an animal that is present in the area of observation must be positioned or behaving in a way that will allow for a visual detection. For example, an animal may not be visually detectable if it is swimming entirely under the water at a relatively far distance from a boat. Second, the observer must perceive the animal when the animal is in a position to be detected (Marsh and Sinclair 1989).

Pursuant to Phase I (e.g., Northwest Training Range Complex EIS/OEIS) and in cooperation with NMFS, the Navy has undertaken monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the impacts of the Navy activities on marine resources. In 2010, the Navy initiated a study designed to evaluate the effectiveness of the Navy Lookout team. The University of St. Andrews, Scotland, under contract to the U.S. Navy, developed an initial data collection protocol for use during the study. Between 2010 and 2012, trained Navy marine mammal observers collected data during nine field trials as part of a “proof of concept” phase. The goal of the proof of concept phase was to develop a statistically valid protocol for quantitatively analyzing the effectiveness of Lookouts during Navy training exercises. Field trials were conducted in the Hawaii Range Complex, Southern California Range Complex, and Jacksonville Range Complex onboard one frigate, one cruiser, and seven destroyers. A preliminary analysis of the proof of concept data is ongoing. The Navy is also working to finalize the data collection process for use during the next phase of the study. While data were collected as part of this proof of concept phase, those data are not fairly comparable as protocols were being changed and assessed, nor are those data statistically significant. Therefore, it is improper to use these data to draw any conclusions on the effectiveness of Navy Lookouts.

5.3.1.2.5.1 Detection Probabilities of Marine Mammals in the Study Area

Until the results of the Navy’s Lookout effectiveness study are available, the Navy must rely on the best available science to determine detection probabilities of marine mammals by Navy Lookouts. To do so, the Navy has compiled the results of available literature on line-transect analyses, which are typically used to estimate cetacean abundance. In line-transect analyses, the factors affecting the detection of an animal or group of animals directly on the transect line may be probabilistically quantified as g(0). As a reference, a g(0) value of 1 indicates that animals on the transect line are always detected. Table 5.3-1 provides detection probabilities for cetacean species based largely on g(0) values derived from shipboard and aerial surveys in the Study Area, which vary widely based on g(0) derivation factors (e.g., species, sighting platforms, group size, and sea state conditions). Refer to Section 3.4.3.1.16 (Implementing Mitigation to Reduce Sound Exposures) for additional background on g(0) and a discussion of how the Navy used g(0) to quantitatively assess the effectiveness of Lookouts during sound-producing activities.

Table 5.3-1: Sightability Based on g(0) Values for Marine Mammal Species in the Study Area

Species/Stocks	Family	Vessel Sightability	Aircraft Sightability
Baird's Beaked Whale	Ziphiidae	0.96	0.18
Blue Whale, Fin Whale, Sei Whale	Balaenopteridae	0.921	0.407
Bottlenose Dolphin	Delphinidae	0.76	0.67
California Sea Lion	Otariidae	0.299	0.299
Cuvier's Beaked Whale	Ziphiidae	0.23	0.074
Dall's Porpoise	Phocoenidae	0.822	0.221
Dwarf Sperm Whale, Pygmy Sperm Whale, *Kogia* spp.	Kogiidae	0.35	0.074
Gray Whale	Eschrichtiidae	0.921	0.482
Harbor Porpoise	Phocoenidae	0.769	0.292
Harbor Seal	Phocidae	0.281	0.281
Humpback Whale	Balaenopteridae	0.921	0.495
Killer Whale	Delphinidae	0.921	0.95
Mesoplodon spp.	Ziphiidae	0.45	0.11
Minke Whale	Balaenopteridae	0.856	0.386
North Pacific Right Whale	Balaenidae	0.645	0.41
Northern Elephant Seal	Phocidae	0.105	0.105
Northern Fur Seal	Otariidae	0.299	0.299
Northern Right Whale Dolphin, Pacific White-Sided Dolphin	Delphinidae	0.856	0.67
Risso's Dolphin, Striped Dolphin	Delphinidae	0.76	0.67
Short-Beaked Common Dolphin	Delphinidae	0.856	0.67
Short-finned Pilot Whale	Delphinidae	0.76	0.67
Sperm Whale	Physeteridae	0.87	0.32
Steller Sea Lion	Otariidae	0.299	0.299

Note: For species having no data, the g(0) for Cuvier's aircraft value (where g(0)=0.074) was used; or in cases where there was no value for vessels, the g(0) for aircraft was used as a conservative underestimate of sightability following the assumption that the availability bias from a slower moving vessel should result in a higher g(0).
Sources: Barlow 2006; Barlow et al. 2006; Barlow and Forney 2007; Carretta et al. 2000; Forney and Barlow 1998; Laake et al. 1997; Palka 2005. The published California Sea Lion aircraft g(0) is used for Steller Sea Lion, Guadalupe Fur Seal, and Northern Fur Seal since all are in the otariidae family and there is no g(0) data for these other species. Pinniped g(0) are not available for vessels so the aircraft value has been used as a conservative under estimate of sightability.

Several variables that play into how easily a marine mammal may be detected by a dedicated observer are directly related to the animal, including its external appearance and size; surface, diving and social behavior; and life history. The following is a generalized discussion of the behavior and external appearance of the marine mammals with the potential to occur in the Study Area as these characters relate to the detectability of each species. The species are grouped loosely based on either taxonomic relatedness or commonalities in size and behavior, and include large whales, cryptic species delphinids, beluga whales, and pinnipeds. Not all statements may hold true for all species in a grouping and exceptions are mentioned where applicable. The information presented in this section may be found in Jefferson et al. (2008) and sources within unless otherwise noted.

Large Whales

Species of large whales found in the Study Area include all the baleen whales and the sperm whale. Baleen whales are generally large, with adults ranging in size from 30 to 89 ft. (9 to 27 m), often making them immediately detectable. Many species of baleen whales have a prominent blow ranging from

10 ft. (3 m) to as much as 39 ft. (12 m) above the surface. However, at least one species (common minke whale) often have no visible blow. Baleen whales tend to travel singly or in small groups ranging from pairs to groups of five. The exception to this is the fin whale, which is known to travel in pods of seven or more individuals. All species of baleen whales are known to form larger-scale aggregations in areas of high localized productivity or on breeding grounds. Baleen whales may or may not fluke at the surface before they dive; some species fluke regularly (humpback whale), some fluke variably (blue whale, fin whale) and some rarely fluke (sei whale and common minke whale). Baleen whales may remain at the surface for extended periods of time as they forage or socialize. Humpback whales are known to corral prey at the surface. Dive behavior varies amongst species, as well. Many species will dive and remain at depth for as long as 30 minutes. Some will adjust their diving behavior according to the presence of vessels (humpback whale, fin whale). Sei whales are known to sink just below the surface and remain there between breaths. Baleen whale g(0) values are shown in Table 5.3-1.

Adult gray whales, included among the large whales, range in size from 38 to 46 ft. (11 to 14 m). When viewed in windless conditions, their blow is heart-shaped, up to 15 ft. (5 m) in height. They typically breathe 3 –5 times in a row, about 10–20 seconds apart, then dive for 3–7 minutes. Gray whales occur within a narrow coastal band and their populations are generally assessed using focused (single-species) count data made from shore stations; g(0) values from vessels are not available for this species and thus estimates from other large baleen whales were used.

Sperm whales are also considered large whales, with adult males reaching as much as 50 ft. (18 m) in total length. Sperm whales at the surface would likely be easy to detect. They are large, have a prominent, 16 ft. (5 m) blow, and may remain at the surface for long periods of time. They are known to raft (i.e., loll at the surface) and to form surface-active groups when socializing. Sperm whales may travel or congregate in large groups of as many as 50 individuals. Although sperm whales engage in conspicuous surface behavior such as fluking, breaching and tail-slapping, they are long, deep divers and may remain submerged for over 1 hour. Sperm whale g(0) values are shown in Table 5.3-1.

Cryptic Species

Cryptic and deep-diving species are those that do not surface for long periods of time and are often difficult to see when they surface, which ultimately limits the ability of Lookouts to detect them even in good sighting conditions (Barlow et al. 2006). Cryptic species include beaked whales (family Ziphiidae), dwarf and pygmy sperm whales (*Kogia* species), and harbor porpoises. Beaked whales are notoriously difficult to detect at sea. In the Study Area, beaked whales may occur in a variety of group sizes, ranging from single individuals to groups of as many as 22 individuals (MacLeod and D'Amico 2006). Beaked whale diving behavior in general consists of long, deep dives that may last for nearly 90 minutes followed by a series of shallower dives and intermittent surfacings (Tyack et al. 2006, Baird et al. 2007). Some individuals remain at the surface for an extended period of time (perhaps 1 hour or more) or make shorter dives (MacLeod and D'Amico 2006). Beaked whale detection is further complicated because they often dive and surface in a synchronous pattern and often travel below the surface of the water (MacLeod and D'Amico 2006). Cryptic beaked whale g(0) values are shown in Table 5.3-1. (Baird's beaked whale is not considered a cryptic species as it is large and relatively easy to detect in comparison to other beaked whale species.)

Dwarf and pygmy sperm whales (referred to broadly as *Kogia* species) are small cetaceans (10–13 ft. [3–4 m] adult length) that are not seen commonly at sea. *Kogia* species g(0) values are shown in Table 5.3-1. *Kogia* species are some of the most commonly stranded species in some areas, which suggests that sightings are not indicative of their overall abundance. This supports the idea that they are cryptic,

perhaps engaging in inconspicuous surface behavior or actively avoiding vessels. When *Kogia* species are sighted, they are seen in groups of no more than five to six individuals. They have no visible blow, do not fluke when they dive, and are known to log (i.e., lie motionless) at the surface. When they do dive, they often will sink out of sight with no prominent behavioral display.

Harbor porpoises are difficult to detect in all but the best of conditions (i.e., no swell, no whitecaps). Harbor porpoise g(0) are shown in Table 5.3-1. Harbor porpoises travel singly or in small groups of less than six individuals, but may aggregate into groups of several hundred. They are inconspicuous at the surface, rarely lifting their heads above the surface and often lying motionless. They are small and may actively avoid vessels.

Delphinids

Delphinids are some of the most likely species to be detected at sea by observers. Delphinid g(0) values are shown in Table 5.3-1. Many species having very high g(0) values, such as the killer whale with values ranging from 0.921 to 0.95 (see Table 5.3-1). Many species of delphinids engage in very conspicuous surface behavior, including leaping, spinning, bow riding, and traveling along the surface in large groups. Delphinid group sizes may range from 10 to 10,000 individuals, depending upon the species and the geographic region. Species such as Pacific white-sided dolphins, bottlenose dolphins, and common dolphins are known to either actively approach and investigate vessels, or bow ride along moving vessels. The physical profile of a killer whale is unmistakable and while at the surface they are easily detected. Common dolphins form huge groups that travel quickly along the surface, churning up the water and making them visible from a great distance. Delphinids may dive for as little as 1 minute to more than 30 minutes, depending upon the species.

Pinnipeds

Pinnipeds (seals and sea lions) are more difficult to detect at sea, but are plentiful in inland waters as compared to cetaceans. There is not a lot of information regarding pinniped behavior at sea, but pinnipeds have been described at length for inland waters. Pinnipeds are much smaller, are often solitary at sea, and they generally do not engage in conspicuous surface behavior. In inland waters they may congregate in large groups and engage in observable behaviors. Pinnipeds have a low profile, no dorsal appendage, and small body size in comparison with most cetaceans, limiting accurate visual detection to sea states of less than 2 on the Beaufort scale (Carretta et al. 2000) at sea. Some species, such as harbor seals, are known to approach and observe human activities in inland waterways, on land, or on stationary vessels.

5.3.1.2.5.2 Detection Probabilities of Sea Turtles in the Study Area

Sea turtles spend a majority of their time below the surface and are difficult to sight from a vessel until the animal is at close range (Hazel et al. 2007). Sea turtles often spend over 90 percent of their time underwater and are not visible more than 6.5 ft. (2 m) below the surface (Mansfield 2006). Sea turtles are generally much smaller than cetaceans, so while shipboard surveys designed for sighting marine mammals are adequate for detecting large sea turtles (e.g., adult leatherbacks), they are usually not adequate for detecting the smaller-sized turtles (e.g., juveniles). Juvenile sea turtles may be especially difficult to detect. Aerial detection may be more effective in spotting sea turtles on the surface, particularly in calm seas and clear water, but it is possible that the smallest age classes are not detected even in good conditions (Marsh and Saalfeld 1989). Visual detection of sea turtles, especially small turtles, is further complicated by their startle behavior in the presence of ships. Turtles on the surface may dive below the surface of the water in the presence of a vessel before it is detected by shipboard or aerial observers (Kenney 2005). The detection probability of sea turtles is generally lower than that of

cetaceans; however, there is no information available on specific g(0) values for turtles. The use of Lookouts for visual detection of sea turtles is likely effective only at close range, and is thought to be less effective for small individuals than large individuals.

5.3.1.2.5.3 Summary of Lookout Effectiveness

Due to the various detection probabilities, levels of experience, and dependence on sighting conditions, Lookouts will not always be effective at avoiding impacts to all species. However, Lookouts are expected to increase the overall likelihood that certain marine mammal species will be detected at the surface of the water, when compared to the likelihood that these same species would be detected if Lookouts are not used. The Navy believes the continued use of Lookouts contributes to helping reduce potential impacts to these marine mammal species from training and testing activities.

5.3.1.2.6 Operational Assessment for Lookouts

As written, implementation of the mitigation measures recommended in Section 5.3.1.2 (Lookouts) is considered an acceptable program with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activities, and Navy policy. The number of Lookouts recommended for each measure often represents the maximum Lookout capacity based on limited resources (e.g., space and manning restrictions).

5.3.2 Mitigation Zone Procedural Measures

Safety zones described in Section 5.1 (Standard Operating Procedures) are zones designed for human safety, whereas this section will introduce mitigation zones. A mitigation zone is designed solely for the purpose of reducing potential impacts on marine mammals and sea turtles from training and testing activities. Mitigation zones are measured as the radius from a source. Unique to each activity category, each radius represents a distance that the Navy will visually observe to help reduce injury to marine species. Visual detections of applicable marine species will be communicated immediately to the appropriate watch station for information dissemination and appropriate action. If the presence of marine mammals is detected acoustically, Lookouts posted in aircraft and on surface vessels will increase the vigilance of their visual surveillance. As a reference, aerial surveys are typically made by flying at 1,500 ft. (460 m) altitude or lower at the slowest safe speed.

Many of the proposed activities have mitigation measures that are currently being implemented, as required by previous environmental documents or consultations. Most of the current Phase I (e.g., Northwest Training Range Complex EIS/OEIS) mitigation zones for activities that involve the use of impulse and non-impulse sources were originally designed to reduce the potential for onset of temporary threshold shift (TTS). For the NWTT EIS/OEIS, the Navy updated the acoustic propagation modeling to incorporate updated hearing threshold metrics (i.e., upper and lower frequency limits), updated density data for marine mammals, and factors such as an animal's likely presence at various depths. An explanation of the acoustic propagation modeling process can be found in the *Determination of Acoustic Effects on Marine Mammals and Sea Turtles for the Northwest Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement* technical report (Marine Species Modeling Team 2013).

As a result of the updates to the acoustic propagation modeling, in some cases the ranges to onset of TTS effects are much larger than those output by previous Phase I models. Due to the ineffectiveness and unacceptable operational impacts associated with mitigating these large areas, the Navy is unable to mitigate for onset of TTS for every activity. In this NWTT analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury,

permanent threshold shift (PTS), out to the predicted maximum range. In some cases where the ranges to effects are smaller than previous models estimated, the mitigation zones were adjusted accordingly to provide consistency across the measures. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also consequently covers the predicted average range to TTS. Table 5.3-2 summarizes the predicted average range to TTS, average range to PTS, maximum range to PTS, and recommended mitigation zone for each activity category, based on the Navy's acoustic propagation modeling results. The predicted ranges are based on local environmental conditions and are unique to the NWTT Study Area.

The activity-specific mitigation zones are based on the longest range for all the functional hearing groups (based on the hearing threshold metrics described in Section 3.4, Marine Mammals, and Section 3.5, Sea Turtles). The mitigation zone for a majority of activities is driven by either the high-frequency cetaceans or the sea turtles functional hearing groups. Therefore, the mitigation zones are even more protective for the remaining functional hearing groups (i.e., low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds), and likely cover a larger portion of the potential range to onset of TTS.

The range to effects for activities using sonar and other active acoustic sources used in the Inland Waters differ from the ranges used in Table 5.3-2 based on Offshore Area activities. For pierside maintenance and testing of hull-mounted mid-frequency sources in the Inland Waters, modeling provides an overestimate of the range to effects because it cannot adequately account for the complex interactions of the sound energy into very shallow water and associated shorelines, the loss into dampening structures (i.e., such as adjacent pilings, jetties, or seawalls), or occasions when a ship or submarine is moored bow in so that the sonar is transmitted toward the nearby shoreline. Therefore, the ranges in Table 5.3-2 are even more protective for activities in the Inland Waters.

In addition to evaluating mitigation zones based on marine mammals and sea turtles, the Navy also evaluated ranges for specific effects to the marbled murrelet. This evaluation included explosive ranges to TTS and the onset of auditory injury, non-auditory injury, slight lung injury, and mortality. For every source proposed for use by the Navy, the recommended mitigation zones included in Table 5.3-2 exceed each of these ranges.

In some instances, the Navy recommends mitigation zones that are larger or smaller than the predicted maximum range to PTS based on the effectiveness and operational assessments. The recommended mitigation zones and their associated assessments are provided throughout the remainder of this section. The recommended measures are either currently implemented, are modifications of current measures, or are new measures.

For some activities specified throughout the remainder of this section, Lookouts may be required to observe for concentrations of detached floating vegetation (*Sargassum* or kelp paddies), which are indicators of potential marine mammal and sea turtle presence within the mitigation zone. Those specified activities will not commence if floating vegetation (*Sargassum* or kelp paddies) is observed within the mitigation zone prior to the initial start of the activity. If floating vegetation is observed prior to the initial start of the activity, the activity will be relocated to an area where no floating vegetation is observed. Training and testing will not cease as a result of indicators entering the mitigation zone after activities have commenced. This measure is intended only for floating vegetation detached from the seafloor.

Table 5.3-2: Predicted Range to Effects and Recommended Mitigation Zones

Activity Category	Representative Source (Bin)[1]	Predicted Average Range to TTS	Predicted Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone
Sonar and Other Active Acoustic Sources					
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar	SQS-53 ASW hull-mounted sonar (MF1)	4,251 yd. (3,887 m)	281 yd. (257 m)	< 292 yd. (< 267 m)	Training: 1,000 yd. (920 m) and 500 yd. (460 m) power downs and 200 yd. (180 m) shutdown for cetaceans and sea turtles, 100 yd. (90 m) mitigation zone for pinnipeds Testing: 1,000 yd. (920 m) for cetaceans, 100 yd. (90 m) for pinnipeds
High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar[2]	AQS-22 ASW dipping sonar (MF4)	226 yd. (207 m)	< 55 yd. (< 50 m)	< 55 yd. (< 50 m)	Training: 200 yd. (180 m) Testing: 200 yd. (180 m) for cetaceans, 100 yd. (90 m) for pinnipeds
Explosive and Impulse Sound					
Improved Extended Echo Ranging Sonobuoys	Explosive sonobuoy (E4)	237 yd. (217 m)	133 yd. (122 m)	235 yd. (215 m)	Training: 600 yd. (550 m) Testing: 600 yd. (550 m)
Signal Underwater Sound (SUS) buoys using 0.6–2.5 lb. NEW	Explosive sonobuoy (E3)	178 yd. (163 m)	92 yd. (84 m)	214 yd. (196 m)	Training: 350 yd. (320 m) Testing: 350 yd. (320 m)
Mine Countermeasure and Neutralization Activities (Time-delay and positive control)	Up to 2.5 lb NEW (E3)	495 yd. (453 m)	145 yd. (133 m)	373 yd. (341 m)	Training: 700 yd. (640 m) Testing: n/a
Gunnery Exercises – Small- and Medium-Caliber (Surface Target)	25 mm projectile (E1)	72 yd. (66 m)	48 yd. (44 m)	73 yd. (67 m)	Training: 200 yd. (180 m) Testing: n/a
Gunnery Exercises – Large-Caliber (Surface Target)	5 in. projectiles (E5 at the surface)[3]	210 yd. (192 m)	110 yd. (101 m)	177 yd. (162 m)	Training: 600 yd. (550 m) Testing: n/a
Missile Exercises up to 500 lb. NEW (Surface Target)	Harpoon missile (E10)	1,164 yd. (1,065 m)	502 yd. (459 m)	955 yd. (873 m)	Training: 2,000 yd. (1.8 km) Testing: n/a
Bombing Exercises	MK-84 2,000 lb. bomb (E12)	1,374 yd. (1,256 m)	591 yd. (540 m)	1,368 yd. (1,251 m)	Training: 2,500 yd. (2.3 km) Testing: n/a
Lightweight Torpedo (Explosive) Testing	MK-46 torpedo (E8)	497 yd. (454 m)	245 yd. (224 m)	465 yd. (425 m)	Training: n/a Testing: 2,100 yd. (1.9 km)
Heavyweight Torpedo (Explosive) Testing	MK-48 torpedo (E11)	1,012 yd. (926 m)	472 yd. (432 m)	885 yd. (809 m)	Training: n/a Testing: 2,100 yd. (1.9 km)

[1] This table does not provide an inclusive list of source bins; bins presented here represent the source bin with the largest range to effects within the given activity category.
[2] High-frequency and non-hull-mounted mid-frequency active sonar category includes unmanned underwater vehicle and torpedo testing activities.
[3] The representative source bin E5 has different range to effects depending on the depth of activity occurrence (at the surface or at various depths).
Notes: ASW = anti-submarine warfare, in. = inch, km = kilometer, m = meter, mm = millimeter, n/a = Not Applicable, NEW = net explosive weight, PTS = permanent threshold shift, TTS = temporary threshold shift, yd. = yard

5.3.2.1 Acoustic Stressors

5.3.2.1.1 Non-Impulse Sound

5.3.2.1.1.1 Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar

Recommended Mitigation and Comparison to Current Mitigation

Under the Proposed Action, low-frequency active sonar would be used only during testing activities conducted in the Offshore Area, the Inland Waters, and the Western Behm Canal, and not during any proposed training activities. Therefore, mitigation measures for low-frequency active sonar sources currently exist only for these testing activities conducted in the Study Area.

Training

The Navy is proposing to (1) continue implementing the current measures for mid-frequency active sonar, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) implement mitigation measures for pinnipeds and for pierside sonar testing in the vicinity of hauled out pinnipeds.

For training activities, the recommended measures are provided below.

Activities that involve the use of hull-mounted mid-frequency active sonar (including pierside) will use Lookouts for visual observation from a ship immediately before and during the activity. Mitigation zones for these activities involve powering down the sonar by 6 dB when a marine mammal is sighted within 1,000 yd. (920 m) of the sonar dome, and by an additional 4 dB when sighted within 500 yd. (460 m) from the source, for a total reduction of 10 dB. Active transmissions will cease if a marine mammal or sea turtle is sighted within 200 yd. (180 m). Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, (4) the ship has transited more than 2,000 yd. (1.8 kilometers [km]) beyond the location of the last sighting, or (5) the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave (and there are no other marine mammal sightings within the mitigation zone). Active transmission may resume when dolphins are bow riding because they are out of the main transmission axis of the active sonar while in the shallow-wave area of the ship bow.

For pinnipeds, the Navy proposes a 100 yd. mitigation zone. The pinniped mitigation zone does not apply for pierside testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

Testing

There are no current hull-mounted mid-frequency active sonar testing activities in the Study Area, and no mitigation procedures. However, the Navy's Proposed Action includes newly assessed hull-mounted mid frequency active sonar testing activities.

For testing activities, the recommended measures are provided below.

Activities that involve the use of low-frequency active sonar (including pierside) will use Lookouts for visual observation immediately before and during the exercise. If a cetacean or sea turtle (pinniped measures are described below) is sighted within 1,000 yd. (920 m) of the sound source, active transmissions will cease. Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any

additional sightings for a period of 30 minutes, or (4) the sound source has transited more than 2,000 yd. (1.8 km) beyond the location of the last sighting.

Activities that involve the use of hull-mounted mid-frequency active sonar (including pierside and shore-based testing) will follow the mitigation measures described above for Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar Training.

For pinnipeds, the Navy proposes a 100 yd. mitigation zone. The pinniped mitigation zone does not apply for pierside testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for low-frequency and hull-mounted mid-frequency active sonar sources is approximately 292 yd. (267 m) for one ping. This range was determined by the high-frequency cetacean functional hearing group. The distance for all other marine mammal functional hearing groups is less than 104 yd. (95 m) for one ping, so the mitigation zone will provide further protection from injury (PTS) for these species. Therefore, implementation of the 200 yd. (183 m) shutdown zone will reduce the potential for exposure to higher levels of energy that would result in injury (PTS) and large threshold shifts that are recoverable (i.e., TTS) when individuals are sighted. Implementation of the 500 yd. (460 m) and 1,000 yd. (920 m) sonar power reductions will further reduce the potential for injury (PTS) and larger threshold shifts that would result in recovery (i.e., TTS) to occur when individual marine mammals are sighted within these zones, especially in cases where the ship and animal are approaching each other.

The mitigation zones the Navy has developed are within a range for which Lookouts can reasonably be expected to maintain situational awareness and visually observe during most conditions. Since the average range to onset of TTS is 4,251 yd. (3,887 m), the entire range to TTS is not reasonably observable. By establishing mitigation zones that can be realistically maintained from ships, Lookouts will be more effective at sighting individual animals. By keeping Lookouts focused within the ranges where exposure to higher levels of energy is possible, the effectiveness at reducing potential impacts to marine mammals and sea turtles will increase. As discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 minutes would result in an unacceptable operational impact on readiness. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles;

and (2) implementation is considered to be acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.1.2 High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar

Recommended Mitigation and Comparison to Current Mitigation

Training

Non-hull-mounted mid-frequency active sonar training activities include the use of aircraft deployed sonobuoys and helicopter dipping sonar. The Navy is proposing to: (1) continue implementing the current mitigation measures for activities currently being executed, such as dipping sonar activities; (2) extend the implementation of its current mitigation to all other activities in this category; and (3) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from a vessel or aircraft (with the exception of platforms operating at high altitudes) immediately before and during active transmission within a mitigation zone of 200 yd. (180 m) from the active sonar source. For activities involving helicopter deployed dipping sonar, visual observation will commence 10 minutes before the first deployment of active dipping sonar. Helicopter dipping and sonobuoy deployment will not begin if concentrations of floating vegetation (kelp paddies), are observed in the mitigation zone. If the source can be turned off during the activity, active transmission will cease if a marine mammal is sighted within the mitigation zone. Active transmission will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for an aircraft-deployed source, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a vessel-deployed source, (5) the vessel or aircraft has repositioned itself more than 400 yd. (370 m) away from the location of the last sighting, or (6) the vessel concludes that dolphins are deliberately closing in to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone).

Testing

Mitigation measures for high-frequency active sonar sources currently exist only for testing activities conducted in the Inland Waters of Puget Sound and in the Western Behm Canal, Alaska. These activities include the use of unmanned vehicles, non-explosive torpedoes, and similar systems. The current mitigation measures used for these testing activities are the same as described above in Section 5.3.2.1.1.1 (Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar).

For all high-frequency and non-hull-mounted mid-frequency active sonar testing activities in the Proposed Action, the Navy proposes to employ the mitigation measures described above for training. For pinnipeds, the Navy proposes a 100 yd.(90 m) mitigation zone during testing. The pinniped mitigation zone does not apply for pierside or shore-based testing in the vicinity of pinnipeds hauled out on man-made structures and vessels.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for high-frequency and non-hull-mounted mid-frequency active sonar sources is less than 55 yd. (50 m) for one ping. This range was the same for all functional hearing groups. The average range to onset of TTS across all functional

hearing groups is 226 yd. (207 m) for one ping. Implementation of the 200 yd. (180 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury (PTS) and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Lookouts often visually observe either close aboard a vessel or from directly above the source by aircraft (i.e., helicopters). Exceptions include when sonobuoys are deployed and when sources are deployed from high altitude aircraft. When sonobuoys are used, the sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly small or cryptic marine mammals, decreases at long distances. This measure should be effective at reducing risks to all marine mammals that are available to be observed within the mitigation zone.

The post-sighting wait periods are designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-minute wait period for vessel-deployed sources more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving species. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur, with the exception of *Kogia* species. Furthermore, any wait period greater than 30 minutes for vessel-deployed sources would result in an unacceptable operational impact on readiness. The 10-minute wait period for aircraft-deployed sources is based on fuel restrictions. Any wait period greater than 10 minutes for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2 Explosives and Impulse Sound

5.3.2.1.2.1 Improved Extended Echo Ranging Sonobuoys

Recommended Mitigation and Comparison to Current Mitigation

Training

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the marine mammal and sea turtle mitigation zone from 1,000 yd. (920 m) to 600 yd. (550 m), (2) clarify the conditions needed to recommence an activity after a sighting, and (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation. The recommended measures are provided below.

Mitigation will include pre-exercise aerial observation and passive acoustic monitoring, which will begin 30 minutes before the first source/receiver pair detonation and continue throughout the duration of the exercise. The pre-exercise aerial observation will include the time it takes to deploy the sonobuoy pattern (deployment is conducted by aircraft dropping sonobuoys in the water). Improved Extended Echo Ranging sonobuoys will not be deployed if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone around the intended deployment location. Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will

recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes

Passive acoustic monitoring would be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would provide only limited range and bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft and on vessels in order to increase vigilance of their visual surveillance.

Testing

The Navy's proposed mitigation measures for testing activities are consistent with Navy training mitigation measures described above.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for Improved Extended Echo Ranging sonobuoys is approximately 235 yd. (215 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 237 yd. (217 m). Implementation of the 600 yd. (550 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 minutes would result in an unacceptable operational impact on readiness. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.2 Explosive Signal Underwater Sound Buoys Using 0.6–2.5 Pound Net Explosive Weight

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for activities using SUS buoys.

Training

The Navy is proposing to add the following recommended measures. Mitigation will include pre-exercise aerial monitoring during deployment within a mitigation zone of 350 yd. (320 m) around an explosive SUS buoy. Explosive SUS buoys will not be deployed if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone (around the intended deployment location). SUS deployment will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Deployment will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Passive acoustic monitoring will also be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft in order to increase vigilance of their visual surveillance.

Testing

The Navy's proposed mitigation measures for testing activities are consistent with Navy training mitigation measures described above.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for explosive SUS buoys using 0.6–2.5 lb. net explosive weight is approximately 214 yd. (196 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 178 yd. (163 m). Implementation of the 350 yd. (320 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and large threshold shifts that are recoverable (i.e., TTS) when individuals are sighted. As discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-minute wait period for this activity, which involves aircraft-deployed sources, is based on fuel restrictions. Any wait period greater than 10 minutes for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine

mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.3 Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices

Recommended Mitigation and Comparison to Current Mitigation

Training

Mine countermeasure and neutralization activities in the Study Area involve the use of diver-placed charges that typically occur close to shore. When these activities are conducted using a positive control firing device, the detonation is controlled by the personnel conducting the activity and is not authorized until the area is clear at the time of detonation. When detonations are not controlled using a positive control firing device they are categorized as time-delay firing devices and are covered in Section 5.3.2.1.2.4 (Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices).

Currently, the Navy employs the following mitigation zone procedures during mine countermeasure and neutralization activities using positive control firing devices:

- Mitigation Zone – All Mine Warfare and Mine Countermeasures Operations involving the use of explosive charges must include mitigation zones for marine mammals and marbled murrelets to prevent physical and/or acoustic effects to those species.
    - The exclusion zone for marine mammals shall extend in a 700 yd. (640 m) arc radius around the detonation site for all charges sizes up to 2.5 lb. net explosive weight.
    - The exclusion zone for marbled murrelets shall extend in a 700 yd. (640 m) arc radius around the detonation site for 2.5 lb. net explosive weight training activities; 330 yd. (300 m) radius for a 1.5 lb. charge and 110 yd. (100 m) radius for a 1-ounce charge.
- Pre-Exercise Surveys – For Demolition and Mine Countermeasures Operations, pre-exercise surveys shall be conducted within 30 minutes prior to the commencement of the scheduled explosive event. The survey may be conducted from the surface, by divers, and/or from the air, and personnel shall be alert to the presence of any marine mammal or seabird. Should such an animal be present within the survey area, the explosive event shall not be started until the animal voluntarily leaves the area. The Navy will ensure the area is clear of marine mammals and seabirds for a full 30 minutes prior to initiating the explosive event. Personnel will record any marine mammal and seabird observations during the exercise as well as measures taken if species are detected within the exclusion zone.
- Post-Exercise Surveys – Surveys within the same radius shall also be conducted within 30 minutes after the completion of the explosive event.

For activities involving positive control diver-placed charges, the Navy is proposing to (1) continue the currently implemented mitigation measures for activities involving up to a 2.5 lb. net explosive weight detonation,
(2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to observe for floating vegetation. The recommended measures for activities involving positive control diver-placed activities are provided below.

The Navy is proposing to use the 700 yd. (640 m) mitigation zones for marine mammals described above during activities involving positive control diver-placed charges. The Navy is also proposing to continue to use the net explosive weight-dependent marbled murrelet mitigation zones described above. Visual observation will be conducted by two small boats, each with a minimum of two surveyors.

Explosive detonations will cease if a marine mammal, flock of seabirds, or individual foraging seabird is sighted in the water portion of the mitigation zone (i.e., not on shore). Detonations will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Immediately following the detonation, visual monitoring for birds within the mitigation zone will take place for 30 minutes. The Navy will report all injured or dead seabirds sighted during the post-detonation observations to the appropriate Navy Region Environmental Director, Navy Pacific Fleet Environmental Office, and local base wildlife biologist.

For training exercises that include the use of multiple detonations, the second (or third, etc.) detonation will occur either immediately after the preceding detonation (i.e., within 10 seconds of the preceding detonation), or after 30 minutes have passed.

Testing

The Navy's Proposed Action does not include mine countermeasure and neutralization testing activities.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. The range to effects shown in Table 5.3-2 for general mine countermeasure and neutralization activities were determined by the high-frequency cetacean functional hearing group, sea turtles, and marbled murrelets. The remaining functional hearing groups had shorter ranges to onset of PTS, so the mitigation zones will provide further protection for these species. Implementing the mitigation zones outlined in Table 5.3-2 will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft or small boats may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation or assistance with mine countermeasure and neutralization deployment. The decrease in mitigation zone size for activities using diver-placed charges will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller area, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Observation of an area beyond what the Navy is proposing to implement would not be likely to result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal.

As described in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), the ability of a Lookout to detect an animal can vary greatly based on what observing platform is being used. For large ranges,

aerial observation is more effective. In addition, when observing from a small boat, sea turtle and cryptic marine mammal species can be very difficult to detect beyond a few meters. However, this measure should be effective at reducing potential impacts for individuals that are sighted.

Mine neutralization activities involving diver-placed charges occur primarily close to shore and in shallow water where only mid-frequency cetaceans and sea turtles are expected to occur with any regularity. The range to effects shown in Table 5.3-2 for mine neutralization activities involving diver placed charges were determined by the sea turtle functional hearing group. The mid-frequency hearing group had shorter ranges to onset of PTS, so the mitigation zones will provide further protection for these species. However, mitigation would be implemented for any species observed within the mitigation zone. Implementation of the mitigation zones outlined in Table 5.3-2 will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The decrease in mitigation zone size for activities using diver placed charges will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller area, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals.

During activities using diver placed charges, Lookouts are visually observing from small boats (rigid hull inflatable boats) or helicopters. As discussed above, aerial observation is more effective than observation from a small boat. Since small boats do not have a very elevating observing platform, the distance over which animals can be observed is much shorter. Sea turtles and cryptic marine mammal species would be very difficult to detect further than a few meters away from the boat.

5.3.2.1.2.4 Mine Neutralization Using Diver-Placed Time-Delay Firing Devices

Training

The Navy's current Lookout procedures during mine countermeasure and neutralization activities using diver-placed time-delay firing devices are the same as described in Section 5.3.2.1.2.3 (Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices).

Testing

The Navy's Proposed Action does not include mine neutralization testing activities.

5.3.2.1.2.5 Gunnery Exercises – Small- and Medium–Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Training

The Navy and USCG are proposing to (1) continue implementing the current mitigation measures for this activity,
(2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to visually observe for kelp paddies.

Mitigation will include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (180 m) around the intended impact location. Vessels will observe the mitigation zone from the firing position. When aircraft are firing, the aircrew will maintain visual watch of the mitigation zone during the activity. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is

thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or (5) the intended target location has been repositioned more than 400 yd. (370 m) away from the location of the last sighting.

Testing

The Navy's Proposed Action does not include gunnery testing activities.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for small and medium caliber gunnery is approximately 73 yd. (67 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 72 yd. (66 m). Implementation of the 200 yd. (180 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

Small-, and medium-caliber gunnery exercises involve the participating vessel or aircraft firing munitions at a target location that may be up to 4,000 yd. (3.7 km) away, although typically much closer than this. Therefore, it is necessary for the Lookout to be able to visually observe the mitigation zone from this distance. Large vessel or aircraft platforms would provide a more effective observation platform for Lookouts than small boats. However, as discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 4,000 yd. (3.7 km). However, this measure is likely effective at reducing the risk of injury to marine mammals that may be observed from the typical target distances. This measure may be ineffective at reducing the risk of injury to sea turtles at large target distances; however, it does reduce the risk for those individuals that may be observed at closer distances. In addition, it is more likely that sea turtles will be observed when exercises involve aircraft versus vessels.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 minutes when vessels are firing would result in an unacceptable operational impact on readiness. The 10-minute wait period when aircraft are firing is based on fuel restrictions. Any wait period greater than 10 minutes when aircraft are firing would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy and USCG propose implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal

species, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy and USCG policy.

5.3.2.1.2.6 Gunnery Exercises – Large-Caliber Explosive Rounds Using a Surface Target

Training

There are currently no existing mitigation measures unique to large-caliber explosive gunnery exercises in the Study Area. The Navy is proposing to adopt mitigation measures in place at other Navy training ranges outside of the Study Area.

Testing

The Navy's Proposed Action does not include gunnery testing activities.

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) implement new mitigation zone measures for this activity, (2) describe conditions needed to recommence an activity after a sighting, and (3) implement a requirement to visually observe for kelp paddies. The recommended measures are provided below.

Mitigation will include visual observation from a ship immediately before and during the exercise within a mitigation zone of 600 yd. (550 m) around the intended impact location. Ships will observe the mitigation zone from the firing position. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for large caliber gunnery is approximately 177 yd. (162 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 210 yd. (192 m). Implementation of the 550 yd. (500 m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Per the Navy's current reporting requirements, any injured or dead marine mammals or sea turtles will be reported as appropriate.

Large caliber gunnery exercises involve the participating ship firing munitions at a target location from ranges up to 6 nm away. Therefore it is necessary for the Lookout to be able to visually observe the mitigation zone from this distance. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen. Although this measure is likely ineffective at reducing the risk of injury to sea turtles and some species of marine mammals, it does reduce the risk for those individuals that may be observed. Observation for indicators of marine

mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 minutes would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation, and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal species; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.7 Missile Exercises up to 250 Pound Net Explosive Weight Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Training

Currently, the Navy employs a mitigation zone of 1,800 yd. (1.6 km) for all missile exercises. Because the Navy is not proposing to use missiles with less than a 251 lb. net explosive weight warhead in the Study Area, separate mitigation procedures for this exercise have not been developed. Should the need arise to conduct training using missiles in this category, the Navy proposes that mitigation procedures be followed as described below for the larger category of missiles (Section 5.3.2.1.2.8, Missile Exercises 251–500 Pound Net Explosive Weight).

5.3.2.1.2.8 Missile Exercises 251–500 Pound Net Explosive Weight (Surface Target)

Recommended Mitigation and Comparison to Current Mitigation

Training

Current mitigation measures apply to all missile exercises, regardless of the warhead size. The Navy proposes to add a mitigation zone that applies only to missiles with a net explosive weight of 251 to 500 lb. The recommended measures are provided below.

When aircraft are involved in the missile firing, mitigation will include visual observation by the aircrew prior to commencement of the activity within a mitigation zone of 2,000 yd. (1.8 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

Testing

The Navy's Proposed Action does not include missile testing activities.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a missile exercise (up to 500 lb. net explosive weight [bin E10]) is approximately 955 yd. (873 m). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 1,164 yd. (1,065 m). Implementing the 2,000 yd. (1.8 km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

Missile exercises involve the aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. There is a chance that animals could enter the impact area after the visual observations have been complete and the activity has commenced. Therefore, this measure is not effective at reducing the risk of injury to animals once the activity has begun, but it does reduce the risk for those individuals that may be observed prior to commencement of the activity when aircraft are firing. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-minute wait period is for aircraft that have fuel restrictions (e.g., helicopters). Any wait period greater than 10 minutes for these types of aircraft would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. The 30-minute wait period is for aircraft that are less restricted by fuel capacities (e.g., maritime patrol aircraft). The 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. Any wait period greater than 30 minutes would result in an unacceptable operational impact on readiness for this type of aircraft.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.9 Bombing Exercises

Recommended Mitigation and Comparison to Current Mitigation

Training

Currently, the Navy employs the following mitigation zone procedures during bombing exercises:

- Ordnance shall not be targeted to impact within 1,000 yd. (920 m) of known or observed floating kelp or marine mammals.
- A 1,000 yd. (920 m) radius mitigation zone shall be established around the intended target.

- The exercise will be conducted only if marine mammals are not visible within the mitigation zone.

The Navy is proposing to (1) maintain the existing mitigation zone to be used for non-explosive bombing activities, (2) revise the mitigation zone procedures to account for predicted ranges to impacts to marine species when high explosive bombs are used, (3) clarify the conditions needed to recommence an activity after a sighting, and (4) add a requirement to visually observe for kelp paddies.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 2,500 yd. (2.3 km) around the intended impact location for explosive bombs and 1,000 yd. (920 m) for non-explosive bombs. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Testing

The Navy's Proposed Action does not include bomb testing activities.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for bombing exercises is approximately 1,368 yd. (1,251 m). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. For example, the maximum range to onset of PTS to mid-frequency of cetaceans is less than 500 yd. (460 m). The average range to onset of TTS across all functional hearing groups is 1,374 yd. (1,256 m). Implementation of the 2,500 yd. (2.3 km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The maximum range to effects on mortality across all functional hearing groups is less than 250 yd. (230 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. As discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2,500 yd. (2.3 km) near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Similarly, Lookouts posted in aircraft during bombing activities will, by necessity, focus their attention on the water surface below and surrounding the location of bomb deployment.

Due to the nature of this activity (e.g., aircraft maintaining a relatively steady altitude of approximately 1,500 ft. [460 m] and approaching the intended impact location), Lookouts will be able to observe a larger area during bombing activities than other proposed activities that involve the use of Lookouts positioned in aircraft (e.g., Improved Extended Echo Ranging sonobuoy activities). However, observation of an area beyond what the Navy is proposing to implement for bombing activities is not practical and would not likely result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal.

The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will likely consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-minute wait period for this activity, which involves aircraft-deployed sources, is based on fuel restrictions. Any wait period greater than 10 minutes for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.10 Torpedo (Explosive) Testing

Recommended Mitigation and Comparison to Current Mitigation

The Navy currently has no mitigation zone procedures for torpedo (explosive) testing in the Study Area.

Training

The Navy does not include training with explosive torpedoes in the Proposed Action.

Testing

The Navy is proposing to (1) establish mitigation measures for this activity that include a mitigation zone of 2,100 yd. (1.9 km), (2) establish the conditions needed to recommence an activity after a sighting, and (3) establish a requirement to visually observe for kelp paddies. The recommended measures are provided below.

Mitigation will include visual observation by aircraft (with the exception of platforms operating at high altitudes) immediately before, during, and after the exercise within a mitigation zone of 2,100 yd. (1.9 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal, sea turtle, or aggregation of jellyfish is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes or 30 minutes (depending on aircraft type).

In addition to visual observation, passive acoustic monitoring will be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. Passive acoustic observation would be accomplished through the use of remote acoustic sensors or expendable sonobuoys, or via passive acoustic sensors on submarines when they participate in the Proposed Action. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to the Lookout posted in the aircraft in order to increase vigilance of the visual surveillance; and to the person in control of the activity for their consideration in determining when the mitigation zone is determined free of visible marine mammals.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential effects they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for explosive torpedoes is approximately 885 yd. (809 m). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 1,012 yd. (926 m). Implementation of the 2,100 yd. (1.9 km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The maximum range to effects on mortality across all functional hearing groups is less than 670 yd. (610 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. As discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2,100 yd. (1.9 km) near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Observation of an area beyond what the Navy is proposing to implement for torpedo (explosive) testing activities is not practical and would not likely result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) and jellyfish aggregations will further help avoid impacts to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-minute wait period is for aircraft that have fuel restrictions (e.g., helicopters). Any wait period greater than 10 minutes for these types of aircraft would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. The 30-minute wait period is for aircraft that are less restricted by fuel

capacities (e.g., maritime patrol aircraft). The 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. Any wait period greater than 30 minutes would result in an unacceptable operational impact on readiness for this type of aircraft.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.11 Weapons Firing Noise During Gunnery Exercises – Large-Caliber

Recommended Mitigation and Comparison to Current Mitigation

The Navy and USCG currently have no mitigation zone procedures for this activity in the Study Area.

Training

The Navy and USCG are proposing to adopt measures currently used during Navy gunnery exercises in other ranges outside of the Study Area. For all explosive and non-explosive large-caliber gunnery exercises conducted from a ship, mitigation will include visual observation immediately before and during the exercise within a mitigation zone of 70 yd. (46 m) within 30 degrees on either side of the gun target line on the firing side. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, or (4) the vessel has repositioned itself more than 140 yd. (128 m) away from the location of the last sighting.

Testing

The Navy's Proposed Action does not include gun testing activities.

Effectiveness Assessment

The mitigation zone is designed to reduce the potential for injury from weapons firing noise during large-caliber gunnery exercises conducted from a ship. The majority of the energy that an animal could be exposed to would occur on the firing side of the vessel and would follow in the direction of fire. It is not operationally feasible to have Lookouts stationed on all sides of the vessel to visually observe for marine mammals and sea turtles due to limited resources (e.g., manning restrictions). Since the Lookout is positioned aboard the firing ship and is visually observing nearby the ship (70 yd. [64 m]), this measure should be effective at reducing the risk to all marine mammals and sea turtles that are available to be observed.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 minutes would result in an unacceptable operational impact on readiness.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2 Physical Disturbance and Strike

5.3.2.2.1 Vessels and In-Water Devices

5.3.2.2.1.1 Vessels

Recommended Mitigation and Comparison to Current Mitigation

Training

The Navy's current measures to mitigate potential impacts to marine mammals from vessel and in-water device strikes during training activities are provided below:

- Naval vessels shall maneuver to keep at least 500 yd. (460 m) away from any observed whale in the vessel's path and avoid approaching whales head-on. These requirements do not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged activities, launching and recovering aircraft or landing craft, minesweeping activities, replenishment while underway and towing activities that severely restrict a vessel's ability to deviate course.
- Vessels will take reasonable steps to alert other vessels in the vicinity of the whale. Given rapid swimming speeds and maneuverability of many dolphin species, naval vessels would maintain normal course and speed on sighting dolphins unless some condition indicated a need for the vessel to maneuver.

The Navy is proposing to continue to use the 500 yd. (460 m) mitigation zone currently established for whales, and to implement a 200 yd. (180 m) mitigation zone for all other marine mammals. Vessels will avoid approaching marine mammals head on and will maneuver to maintain a mitigation zone of 500 yd. (460 m) around observed whales and 200 yd. (180 m) around all other marine mammals (except bow-riding dolphins), providing it is safe to do so.

Testing

The Navy's current measures to mitigate potential impacts to marine mammals from vessel and in-water device strikes during testing activities are provided below:

- Range activities shall be conducted in such a way as to ensure marine mammals are not harassed or harmed by human-caused events.
- Visual surveillance shall be accomplished just prior to all in-water exercises. This surveillance shall ensure that no marine mammals are visible within the boundaries of the area within which the test unit is expected to be operating. Surveillance shall include, as a minimum, monitoring from all participating surface craft and, where available, adjacent shore sites.
- The Navy shall postpone activities until cetaceans (whales, dolphins, and porpoises) leave the activity area. When cetaceans have been sighted in an area, all range participants increase vigilance and take reasonable and practicable actions to avoid collisions and activities that may result in close interaction of naval assets and marine mammals. Actions may include changing

speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).

- Range craft shall not approach within 100 yd. (90 m) of marine mammals and shall be followed to the extent practicable considering human and vessel safety priorities. All Navy vessels and aircraft, including helicopters, are expected to comply with this directive. This includes marine mammals "hauled-out" on islands, rocks, and other areas such as buoys.

The Navy is proposing to incorporate the training mitigation measures described above during testing activities involving surface ships, and for all other testing activities to continue using the mitigation measures currently implemented, revised to exclude pinnipeds during test body retrieval and to include the exception for bow-riding dolphins as described above under Training.

Effectiveness and Operational Assessments

Since the Lookout is visually observing within a reasonable distance of the vessel (within 100 yd. [90 m] for testing activities and within 500 yd. [460 m] for training activities), this measure should be effective at reducing the risk to marine mammals that are available to be observed. However, as discussed above in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), large whales and pods of dolphins are more likely to be seen than other more cryptic species, such as beaked whales.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.1.2 Towed In-Water Devices

Recommended Mitigation and Comparison to Current Mitigation

The Navy currently has no mitigation zone procedures for this activity in the Study Area.

Training

The Navy is proposing to adopt measures currently used in other ranges outside of the Study Area during activities involving towed in-water devices. The Navy will ensure that towed in-water devices being towed from manned platforms avoid coming within a mitigation zone of 250 yd. (230 m) around any observed marine mammal, providing it is safe to do so.

Testing

The Navy is proposing to use the same mitigation measures during testing activities as described in Section 5.3.2.2.1.1 (Vessels).

Effectiveness and Operational Assessments

Since the Lookout is visually observing within a reasonable distance of the vessel (within 100 yd. [90 m] for testing activities and 250 yd. [230 m] for training activities), this measure should be effective at reducing the risk to marine mammals that are available to be observed. However, as discussed above in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), large whales and pods of dolphins are more likely to be seen than other more cryptic species such as beaked whales.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to marine mammals; and (2) implementation has been

analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2 Non-Explosive Practice Munitions

5.3.2.2.2.1 Gunnery Exercises – Small, Medium-, and Large-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Training

Currently, the Navy and USCG employ the same mitigation measures for non-explosive gunnery exercises as described above in 5.3.2.1.2.5 (Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target).

The Navy and USCG are proposing to (1) continue using the mitigation measures currently implemented for this activity, and (2) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (180 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 minutes for a firing ship, or (5) the intended target location has been repositioned more than 400 yd. (370 m) away from the location of the last sighting.

Testing

The Navy's Proposed Action does not include gunnery testing activities.

Effectiveness and Operational Assessments

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive projectile. Large-caliber gunnery exercises involve the participating ship or aircraft firing munitions at a target location from ranges up to 6 nm away. Small- and medium-caliber gunnery exercises involve the participating vessel or aircraft firing munitions at a target location from up to 2 nm away, although typically closer. Therefore, it is necessary for the Lookout to be able to visually observe the mitigation zone from these distances. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.5 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen. Although this measure is likely ineffective at reducing the risk of injury to sea turtles and some species of marine mammals, it does reduce the risk for those individuals that may be observed.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-minute wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1 (Acoustic Stressors) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Furthermore, any wait period greater than 30 minutes would result in an unacceptable operational impact on readiness.

The 10-minute wait period when aircraft are firing is based on fuel restrictions. Any wait period greater than 10 minutes when aircraft are firing would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to some species of marine mammals; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2.2 Bombing Exercises

Recommended Mitigation and Comparison to Current Mitigation

Training

The Navy is proposing to continue using the mitigation measures currently implemented for this activity. The recommended measure includes clarification of a post-sighting activity recommencement criterion.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 1,000 yd. (920 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 minutes.

Testing

The Navy's Proposed Action does not include bomb testing activities.

Effectiveness and Operational Assessments

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-minute wait period for this activity, which involves aircraft-deployed sources, is based on fuel restrictions. Any wait period greater than 10 minutes for an aircraft-deployed source would result in an unacceptable operational impact on readiness and safety of personnel. The 10-minute wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [kelp paddies]) will further help avoid impacts to marine mammals and sea turtles.

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive bomb. The Navy proposes implementing the recommended measure described above because: (1) it is likely to result in avoidance or reduction of injury to marine mammals or sea turtles; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3 MITIGATION AREAS

The Navy currently applies area-specific mitigation measures only for the marbled murrelet as described below.

Marbled Murrelet Mitigation

The following marbled murrelet mitigation procedural measures exist for testing activities conducted in the Inland Waters:

- During the marbled murrelet nesting season (1 April–15 September) avoid sonar testing, where feasible, during the period from 2 hours before sunrise to 2 hours after sunrise.
- Where practicable (as determined by the Navy) during the summer, conduct long duration (exceeding 30 minutes) countermeasures tests in the Keyport Range Site instead of the Dabob Bay Range Complex Site.
- Where practicable (as determined by the Navy), conduct countermeasure testing activities during the summer rather than the winter.

The Navy is proposing to eliminate the marbled murrelet mitigation measures described above. There is no evidence to support that marbled murrelet hearing is within the frequency ranges of the sound sources used (e.g., sonar and countermeasures) in these tests. Therefore, these mitigation measures would provide no added benefit. The Navy is currently in consultation with USFWS on this and other issues related to potential impacts on the marbled murrelet.

5.3.4 MITIGATION MEASURES CONSIDERED BUT ELIMINATED

A number of mitigation measures were suggested during the public comment periods of previous Navy environmental documents. As a result of the assessment process identified in Section 5.2 (Introduction to Mitigation), the Navy determined that some of the suggested measures would likely be ineffective at reducing environmental impacts, have an unacceptable operational impact based on the effectiveness assessment, or be incompatible with Section 5.2.2 (Overview of Mitigation Approach). The measures that the Navy does not recommend for implementation are discussed in Section 5.3.4.1 (Previously Considered but Eliminated) and Section 5.3.4.2 (Previously Accepted but Now Eliminated).

There is a distinction between effective and feasible observation procedures for data collection and measures employed to prevent impacts or otherwise serve as mitigation. The discussion below is in reference to those procedures meant to serve as mitigation measures.

5.3.4.1 Previously Considered but Eliminated

5.3.4.1.1 Reducing Amount of Training and Testing Activities

Reducing training and testing for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

The requirements to train are designed to provide the experience needed to ensure Sailors are properly prepared for operational success. Training requirements have been developed through many years of iteration and are designed to ensure Sailors achieve the levels of readiness needed to properly respond to the many contingencies that may occur during an actual mission. The Proposed Action does not include training beyond levels required for maintaining satisfactory levels of readiness due to the need to efficiently use limited resources (e.g., fuel, personnel, and time). Therefore, any reduction of training would not allow Sailors to achieve satisfactory levels of readiness needed to accomplish their mission.

The requirements to test systems prior to their implementation in military activities are identified in DoD Directive 5000.1. This directive states that test and evaluation support is to be integrated throughout the defense acquisition process. The Navy rigorously collected data during the developmental stages of this EIS/OEIS to accurately quantify test activities necessary to meet requirements of DoD Directive 5000.1. These testing requirements are designed to determine whether systems perform as expected and are operationally effective, suitable, survivable, and safe for their intended use. Any reduction of testing activities would not allow the Navy to meet its purpose and need to achieve requirements set forth in DoD Directive 5000.1.

5.3.4.1.2 Replacing Training and Testing with Simulated Activities

Replacing training and testing activities with simulated activities for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

As described in Section 2.5.1.4 (Simulated Training and Testing), the Navy currently uses computer simulation for training and testing whenever possible. Computer simulation can provide familiarity and complement live training; however, it cannot provide the fidelity and level of training necessary to prepare naval forces for deployment.

The Navy is required by law to operationally test major platforms, systems, and components of these platforms and systems in realistic combat conditions before full-scale production can occur. Substituting simulation for live training and testing fails to meet the purpose of and need for the Proposed Action and therefore was eliminated from consideration as a mitigation measure.

5.3.4.1.3 Reducing Sonar Source Levels and Total Number of Hours

Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform's presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission. Reducing active sonar source levels and the total number of active sonar hours used during training and testing activities for the purpose of mitigation would adversely impact the effectiveness of military readiness activities and increase safety risks to personnel for the following reasons:

Sonar operators need to train as they would operate during real combat situations. Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, sonar equipment power levels are always set consistent with mission requirements. Reducing sonar source levels for the purpose of mitigation precludes sonar operators from learning to operate the sonar systems with their entire range of capabilities throughout the extremely diverse range of environmental conditions they may encounter. Failure to train with the entire range of capabilities will reduce the effectiveness of the sonar operators should their skills be required during real world events. Not only would they not develop the skills necessary to identify and track submarines at the maximum distances of their systems capabilities, they would not learn how to use their systems' capabilities during the entire range of environmental conditions they may encounter. Likewise, they would not develop the knowledge of how to fully integrate multiple ASW capabilities, including other ships and aircraft into an integrated ASW team.

Failure to train with the entire range of capabilities also compromises training by reducing the ability for a sonar operator to detect, track, and hold an enemy target, mine, or other object, and by reducing the realism of other training scenarios (e.g., navigation training). Particularly during a strike group exercise, sonar operators need to learn to handle real world combat situations (e.g., the ability to manage sonar

operations during periods of mutual interference, which can occur when more than one sonar system is operating simultaneously). Training with reduced sonar source levels would ultimately condition Sailors to expect conditions that they would not experience in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the strike group's ability to achieve mission success. The Navy must test its systems in the same way they would be used for military readiness activities. Reducing sonar source levels during testing would impact the ability to determine whether systems are operationally effective, suitable, survivable, and safe. Ultimately, reducing sonar source levels would reduce training and testing realism. Reducing the total number of sonar hours used during training and testing would prevent the Navy from meeting its military readiness qualification standards.

5.3.4.1.4 Implementing Active Sonar Ramp-Up Procedures during Training

Implementing active sonar ramp-up procedures (slowly increasing the sound in the water to necessary levels) in an attempt to clear the range prior to conduct of activities for the purpose of mitigation during training activities would result in an unacceptable impact on readiness and would not necessarily be effective at reducing potential impacts on marine species for the following reason:

Ramp-up procedures would alert opponents to the participants' presence. This would consequently negatively affect the realism of training because the target submarine could detect the searching unit before the searching unit could detect the target submarine, enabling the target submarine to take evasive measures. This is not representative of a real-world situation and thereby would impact training realism and effectiveness. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the sonar operator's ability to achieve mission success.

Although ramp-up procedures have been used for some testing activities, effectiveness at avoiding or reducing impacts on marine mammals has not been demonstrated. Until evidence suggests that ramp-up procedures are an effective means of avoiding or reducing potential impacts on marine mammals, the Navy is proposing to eliminate the implementation of this measure for testing activities as part of the Proposed Action.

5.3.4.1.5 Reducing Vessel Speed

As described in Section 5.1.1.1.1 (Vessel Safety), as a standard operating procedure, Navy personnel are required to use appropriate caution and operate at a slow, safe speed consistent with mission and safety. These standard operating procedures are designed to allow a vessel to take proper and effective action to avoid a collision with any sighted object or disturbance (which may include a marine mammal) and to stop within a distance appropriate to the prevailing circumstances and conditions. Implementing widespread reductions in vessel speed throughout the Study Area for the purpose of mitigation would be impractical with regard to military readiness activities, and result in an unacceptable impact on readiness for the following reasons:

Vessel operators need to be able to react to changing tactical situations and evaluate system capabilities in training and testing as they would in actual combat. Widespread speed restrictions would not allow the Navy to properly test vessel capabilities or train to react to these situations. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the vessel operator's ability to achieve mission success.

5.3.4.1.6 Limiting Access to Training and Testing Locations

Limiting training and testing activities to specific locations for the purpose of mitigation would be impractical with regard to implementation, would adversely impact the effectiveness of military readiness activities, and would increase safety risks to personnel for the following reasons:

As described in Section 2.5.1.1 (Alternative Locations), the ability to use the diverse and multidimensional capabilities of each range complex and testing range results in the Navy's ability to develop and maintain high levels of readiness. Major exercises using integrated warfare components require large areas of the littorals, open ocean, and certain nearshore areas for realistic and safe training. Limiting training and testing (including the use of sonar and other active acoustic sources or explosives) to specific locations (e.g., abyssal waters and surveyed offshore waters) and avoiding areas (e.g., embayments or large areas of the littorals and open ocean) would be impractical to implement with regard to the need to conduct activities in proximity to certain facilities and range complexes. These restrictions would also adversely impact the safety of the training and testing activities by requiring activities to take place in more remote areas where safety support may be limited.

Training and testing activities require continuous access to large areas consisting potentially of thousands of square miles of ocean and air space to provide naval personnel the ability to train with and develop competence and confidence in their capabilities and their entire suite of weapons and sensors. Exercises may change mid-stream based on evaluators' assessments of performance and other conditions including weather or mechanical issues. These may preclude use of a permission scheme for access to water space. Threats to national security are constantly evolving and the Navy requires the ability to adapt training to meet these emerging threats as well as develop and test systems to effectively operate in these environments. Restricting access to limited locations would impact the ability of Navy training and testing to evolve as the threat evolves. Operational units already incorporate requirements for safety of personnel including air space and shipping routes. Safety restrictions may include limits on distance from military air fields during carrier flight operations and air traffic corridors for safety of military and civilian aviation. These types of limitations shape how exercise planners develop and implement training scenarios including those involving defense of aircraft carriers from submarines.

Therefore, limiting access to training and testing locations would reduce realism of activities by restricting access to important real world combat situations, such as bathymetric features and varying oceanographic features. As described in Section 5.3.4.1.7 (Avoiding Locations Based on Bathymetry and Environmental Conditions), Sailors must be trained to handle bottom bounce, sound passing through changing currents, eddies, or across changes in ocean temperature, pressure, or salinity. Training in a few specific locations would alter Sailors' abilities to effectively operate in varying real world combat situations, thereby resulting in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

5.3.4.1.7 Avoiding Locations Based on Bathymetry and Environmental Conditions

Avoiding locations for training and testing activities based on bathymetry and environmental conditions for the purpose of mitigation would increase safety risks to personnel and result in an unacceptable impact on readiness for the following reasons:

Areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. As described in Section 2.5.1.1 (Alternative Locations), the varying environmental conditions of the Study Area (e.g., bathymetry and topography) maximize the training

realism and testing effectiveness. Limiting training and testing (including the use of sonar and other active acoustic sources or explosives) to avoid steep or complex bathymetric features (e.g., submarine canyons and large seamounts) and oceanographic features (e.g., surface fronts and variations in sea surface temperatures) would reduce the realism of the military readiness activity. Systems must be tested in a variety of bathymetric and environmental conditions to ensure functionality and accuracy in a variety of environments. Sonar operators need to train as they would operate during real world combat situations. Because real world combat situations include diverse bathymetric and environmental conditions, Sailors must be trained to handle bottom bounce, sound passing through changing currents, eddies, or across changes in ocean temperature, pressure, or salinity. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the sonar operator's ability to achieve mission success.

5.3.4.1.8 Avoiding or Reducing Active Sonar at Night and During Periods of Low Visibility

Avoiding or reducing active sonar at night and during periods of low visibility for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

The Navy must train in the same manner as it will fight. Anti-submarine warfare can require a significant amount of time to develop the "tactical picture," or an understanding of the battle space (e.g., area searched or unsearched, identifying false contacts, and understanding the water conditions). Reducing or securing power in low-visibility conditions would affect a commander's ability to develop this tactical picture and would not provide the needed training realism. Training differently from what would be needed in an actual combat scenario would decrease training effectiveness, reduce the crew's abilities, and introduce an increased safety risk to personnel.

Mid-frequency active sonar training is required year-round in all environments, including night and low-visibility conditions. Training occurs over many hours or days, which requires large teams of personnel working together in shifts around the clock to work through a scenario. Training at night is vital because environmental differences between day and night affect the detection capabilities of sonar. Temperature layers that move up and down in the water column and ambient noise levels can vary significantly between night and day, which affects sound propagation and could affect how sonar systems are operated. Consequently, personnel must train during all hours of the day to ensure they identify and respond to changing environmental conditions, and not doing so would unacceptably decrease training effectiveness and reduce the crews' abilities. Therefore, the Navy cannot operate only in daylight hours or wait for the weather to clear before training.

The Navy must test its systems in the same way they would be used for military readiness activities. Reducing or securing power in adverse weather conditions or at night would impact the ability to determine whether systems are operationally effective, suitable, survivable, and safe. Additionally, some systems have a nighttime testing requirement. Therefore, Navy personnel cannot operate only in daylight hours or wait for the weather to clear before or during all test events.

5.3.4.1.9 Avoiding or Reducing Active Sonar during Strong Surface Ducts

Avoiding or reducing active sonar during strong surface ducts for the purpose of mitigation would increase safety risks to personnel, be impractical with regard to implementation of military readiness activities, and result in an unacceptable impact on readiness for the following reasons:

The Navy must train in the same manner as it will fight. Anti-submarine warfare can require a significant amount of time to develop the "tactical picture," or an understanding of the battle space such as area searched or unsearched, identifying false contacts, understanding the water conditions, etc. Surface ducting is a condition when water conditions (e.g., temperature layers, lack of wave action) result in little sound energy penetrating beyond a narrow layer near the surface of the water. Submarines have long been known to exploit the phenomena associated with surface ducting. Therefore, training in surface ducting conditions is a critical component to military readiness because sonar operators need to learn how sonar transmissions are altered due to surface ducting, how submarines may take advantage of them, and how to operate sonar effectively in this environment. Avoiding or reducing active sonar during surface ducting conditions would affect a commander's ability to develop this tactical picture and would not provide the needed training realism. Diminished realism would reduce a sonar operator's ability to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

Furthermore, avoiding surface ducting would be impractical to implement because ocean conditions contributing to surface ducting change frequently, and surface ducts can be of varying duration. Surface ducting can also lack uniformity and may or may not extend over a large geographic area, making it difficult to determine where to reduce power and for what periods.

5.3.4.1.10 Avoiding Locations Based on Distances from Isobaths or Shorelines

Avoiding locations for training and testing activities within the Study Area based on wide-scale distances from isobaths or the shoreline for the purpose of mitigation would be impractical with regard to implementation of military readiness activities, result in unacceptable impact on readiness, and would not be an effective means of mitigation, and would increase safety risks to personnel for the following reasons:

A measure requiring avoidance of mid-frequency active sonar within 13 nm of the 656 ft. (200 m) isobaths was part of the Rim of the Pacific exercise 2006 authorization by NMFS. This measure, as well as similar measures of like distances, lacks any scientific basis when applied to the context of the Study Area (e.g., bathymetry, sound propagation, and width of channels). There is no scientific analysis indicating this measure is protective and no known basis for these specific metrics. The Rim of the Pacific 2006 exercise mitigation measure precluded active anti-submarine training in the littoral region, which significantly impacted realism and training effectiveness (e.g., protecting ships from submarine threats during amphibious landings). This mitigation procedure had no observable effect on the protection of marine mammals during Rim of the Pacific 2006 exercises, and its value is unclear; however, its adverse effect on realistic training, as with all arbitrary distance from land restrictions, is significant.

Training in shallower water is an essential component to maintaining military readiness. Sound propagates differently in shallower water and operators must learn to train in this environment. Additionally, submarines have become quieter through the use of improved technology and have learned to hide in the higher ambient noise levels of the shallow waters of coastal environments. In real world events, it is highly likely Sailors would be working in, and therefore must train in, these types of areas.

Areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. The proximity to facilities, range complexes, and testing ranges is essential to the training and testing realism and effectiveness required to train and certify naval forces ready for

combat operations. Limiting access to coastal areas would restrict access to certain training and testing locations and would increase transit time for these activities, which would result in an increased risk to personnel safety, particularly for platforms with fuel restrictions (e.g., aircraft) or for certain activities such as mine countermeasures and neutralization activities using diver-placed mines.

The ability to use the diverse and multi-dimensional capabilities of each range complex and testing range results in the Navy's ability to develop and maintain high levels of readiness. Otherwise limiting training and testing (including the use of sonar and other active acoustic sources or explosives) to avoid arbitrary distances from isobaths or the shoreline would adversely impact the effectiveness of the training and testing. This includes avoiding conducting activities within 12 nm from shore, 25 nm from shore, between shore and the 20 m isobath, and 13 nm out from the 656 ft. (200 m) isobath. Operating in shallow water is essential in order to provide realistic training on real world combat conditions with regard to shallow water sound propagation.

5.3.4.1.11 Avoiding Marine Species Habitats

Navy has recommended measures within several mitigation areas (see Section 5.3.3, Mitigation Areas) that have been well-documented as important habitats for particular species and in which implementation of mitigation would not result in unacceptable impacts on readiness. These mitigation areas have been carefully selected on a case-by-case basis through consultation with NMFS and the USFWS. Otherwise avoiding all marine species habitats (e.g., foraging locations, reproductive locations, migration corridors, and locations of modeled takes) for the purpose of mitigation would be impractical with regard to implementation of military readiness activities, would result in unacceptable impact on readiness, and would increase safety risks to personnel for the following reasons:

As described in Section 5.3.4.1.6 (Limiting Access to Training and Testing Locations) and Section 5.3.4.1.7 (Avoiding Locations Based on Bathymetry and Environmental Conditions), areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events, and the varying environmental conditions of these areas maximize the training realism and testing effectiveness. Activity locations inevitably overlap a wide array of marine species habitats, including foraging habitats, reproductive areas, and migration corridors. Otherwise limiting activities to avoid these habitats would adversely impact the effectiveness of the training or testing activity, and would therefore result in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

As described in the *Determination of Acoustic Effects on Marine Mammals and Sea Turtles for the Northwest Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement* technical report (Marine Species Modeling Team 2013), modeling locations were developed based on historical data and anticipated future needs. The model does not provide information detailed enough to analyze or compare locations based on potential take levels for each activity; therefore, applying the modeling results to inform development of mitigation areas would not be appropriate.

5.3.4.1.12 Avoiding Marine Protected Areas

Avoiding marine protected areas for the purpose of mitigation would increase safety risks to personnel, be impractical with regard to implementation, and would not be warranted based on the discussions presented in the Chapter 3 (Affected Environment and Environmental Consequences) environmental analyses for biological resources and Section 6.1.2 (Marine Protected Areas).

Areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. The proximity to facilities, range complexes, and testing ranges is essential to the training and testing realism and effectiveness required to train and certify naval forces ready for combat operations. Limiting access to marine protected areas would restrict access to training and testing locations and would increase transit time, which would result in an increased risk to personnel safety, particularly for platforms with fuel restrictions (e.g., aircraft).

As described in Section 6.1.2 (Marine Protected Areas), due to the nature of many training and testing activities (e.g., requiring deep water), proposed activities are unlikely to occur in the extremely shallow nearshore waters typical of most marine protected areas. Within most marine protected areas, the only activity likely to occur is an aircraft overflight during transit from an airfield to an offshore training or testing location. Exposure of marine protected area resources to aircraft overflights would be brief and is expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals, sea turtles, birds, or fish that may be present in the area. There is potential for birds to be struck by aircraft; however, the Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike. Additional mitigation or avoidance of these marine protection areas would be unnecessary, and limiting passage through the areas would restrict direct access to training and testing locations. Such avoidance would ultimately increase transit time and for platforms with fuel restrictions (e.g., aircraft) would therefore result in an unacceptable increased risk to personnel safety.

For marine protected areas (e.g., gear restricted areas) located further offshore, activities in addition to aircraft overflights may occur. Refer to Section 6.1.2 (Marine Protected Areas) for a more detailed discussion on the activities that are expected to occur within marine protected areas in the Study Area. Ultimately, limiting access to training and testing locations that overlap, are contained within, or are adjacent to marine protected areas would reduce realism of training by restricting access to important real world combat situations, such as bathymetric features and varying oceanographic features. As described in Section 2.5.1.1 (Alternative Locations), the ability to use the diverse and multidimensional capabilities of each range complex and testing range results in the Navy's ability to develop and maintain high levels of readiness. Major exercises using integrated warfare components require large areas of the littorals, open ocean, and certain nearshore areas for realistic and safe training. Limiting training and testing to specific locations and avoiding all marine protected areas would be impractical to implement with regard to the need to conduct activities in proximity to certain facilities, range complexes, and testing ranges. The Navy typically conducts activities in proximity to certain facilities, range complexes, and testing ranges in order to reduce travel time and funding required to conduct training away from a unit's home base. Activities involving the use of helicopters typically occur in proximity to shore or refueling stations due to fuel restrictions and personnel safety. Training and testing location limitations would also adversely impact the safety of the training and testing activities by requiring activities to take place in more remote areas where safety support may be limited. Refer to Section 5.3.4.1.6 (Limiting Access to Training and Testing Locations) for further discussion on the impacts of limiting access to training and testing locations on the Navy's ability to maintain military readiness.

5.3.4.1.13 Increasing Visual and Passive Acoustic Observations

Increasing visual and passive acoustic observations for the purpose of mitigation would be impractical with regard to implementation of military readiness activities and result in unacceptable impact on readiness for the following reasons:

The Navy recommended mitigation measures already represent the maximum level of effort (e.g., numbers of Lookouts and passive sonobuoys) that the Navy can commit to observing mitigation zones given the number of personnel that will be involved and the number and type of assets and resources available. The number of Lookouts that the Navy recommends for each measure often represents the maximum capacity based on limited resources (e.g., space and manning restrictions). For example, some vessels are minimally manned and are therefore physically unable to accommodate more than one Lookout. Furthermore, training and testing activities are carefully planned with regard to personnel duties. Requiring additional Lookouts would either require adding personnel, for which there would be no additional space, or reassigning duties, which would divert Navy personnel from essential tasks required to meet mission objectives.

The Navy will conduct passive acoustic monitoring during several activities with Navy assets, such as sonobuoys, already participating in the activity (e.g., torpedo [explosive] testing and improved extended echo ranging sonobuoys). Refer to Section 5.3.2 (Mitigation Zone Procedural Measures) for additional information on the use of passive acoustics during training and testing activities. The Navy does not have the resources to construct and maintain additional passive acoustic monitoring systems for each training and testing activity.

5.3.4.1.14 Increasing the Size of Observed Mitigation Zones

Increasing the size of observed mitigation zones for the purpose of mitigation would be impractical with regard to implementation of military readiness activities and result in unacceptable impact on readiness for the following reasons:

The Navy developed activity-specific mitigation zones based on the Navy's acoustic propagation model. In this NWTT analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, PTS, out to the predicted maximum range. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also covers the predicted average range to TTS. In some instances, the Navy recommends mitigation zones that are larger or smaller than the predicted maximum range to PTS based on the associated effectiveness and operational assessments presented in Section 5.3.2 (Mitigation Zone Procedural Measures).

The Navy recommended mitigation zones represent the maximum area the Navy can effectively observe based on the platform of observation, number of personnel that will be involved, and the number and type of assets and resources available. As mitigation zone sizes increase, the potential for reducing impacts decreases. For instance, if a mitigation zone increases from 1,000 to 4,000 yd. (920 to 3,660 m), the area that must be observed increases sixteen-fold. The Navy recommended mitigation measures balance the need to reduce potential impacts with the ability to provide effective observations throughout a given mitigation zone. Implementation of mitigation zones is most effective when the zone is appropriately sized to be realistically observed. The Navy does not have the resources to maintain additional Lookouts or observer platforms that would be needed to effectively observe mitigation zones of increased size. Further, as explained above, the number of Lookouts that the Navy recommends for each measure often represents the maximum capacity based on limited resources (e.g., space and manning restrictions). For example, some vessels are minimally manned and are therefore physically unable to accommodate more than one Lookout. Training and testing activities are carefully planned with regard to personnel duties. Requiring observation of mitigation zones of increased size would

either require adding personnel, for which there would be no additional space or resources, or reassigning duties, which would divert Navy personnel from essential tasks required to meet mission objectives. For most activities, Lookouts are required to observe for concentrations of detached floating vegetation (*Sargassum* or kelp paddies), which are indicators of potential marine mammal and sea turtle presence, within the mitigation zone to further help reduce the potential for injury to occur.

5.3.4.1.15 Conducting Visual Observations Using Third-Party Observers

With limited exceptions, use of third-party observers (e.g., trained marine species observers) in air or on surface platforms in addition to existing Navy Lookouts for the purposes of mitigation would be impractical with regard to implementation of military readiness activities and result in unacceptable impact on readiness for the following reasons:

Use of third-party observers is not necessary because Navy personnel are extensively trained in spotting items on or near the water surface. Use of Navy Lookouts ensures immediate implementation of mitigation if marine species are sighted. A critical skill set of effective Navy training is communication. Navy Lookouts are trained to act swiftly and decisively to ensure that appropriate actions are taken. Additionally, multiple training and testing events can occur simultaneously and in various regions throughout the Study Area, and can last for days or weeks at a time. The Navy does not have the resources to maintain third-party personnel to accomplish the task for every event.

The use of third-party observers would compromise security for some activities involving active sonar due to the requirement to provide advance notification of specific times and locations of Navy platforms. Reliance on the availability of third-party personnel would impact training and testing flexibility. The presence of other aircraft in the vicinity of naval activities would raise safety concerns for both the commercial observers and naval aircraft. Furthermore, vessels have limited passenger capacity. Training and testing event planning includes careful consideration of this limited capacity in the placement of personnel on ships involved in the event. Inclusion of non-Navy observers onboard these vessels would require that in some cases there would be no additional space for essential Navy personnel required to meet the exercise objectives.

The areas where training events will most likely occur in the Study Area cover more than 120,000 square nautical miles. Contiguous ASW events may cover many hundreds or even thousands of square miles. The number of civilian ships or aircraft required to monitor the area of these events would be considerable. It is, thus, not feasible to survey or monitor the large exercise areas in the time required. In addition, marine mammals may move into or out of an area, if surveyed before an event, or an animal could move into an area after an event took place. Given that there are no adequate controls to account for these or other possibilities, there is little utility to performing extensive before or after event surveys of large exercise areas as a mitigation measure.

Surveying during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, many of the training and testing events take place far from land, limiting both the time available for civilian aircraft to be in the event area and presenting a concern should aircraft mechanical problems arise. Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the progress of the exercise and impact the effectiveness of the military readiness activity.

5.3.4.1.16 Adopting Mitigation Measures of Foreign Navies

Adopting mitigation measures of foreign navies generally for the purpose of mitigation, such as expanding the mitigation zones to match those used by a particular foreign navy, would be impractical with regard to implementation of military readiness activities and result in unacceptable impact on readiness for the following reasons:

Mitigation measures are carefully customized for and agreed upon by each individual navy based on potential impacts of the activities on marine species and the impacts of the mitigation measures on military readiness. The mitigation measures developed for one navy would not necessarily be effective at reducing potential impacts on marine species by all navies. Similarly, mitigation measures that do not cause an unacceptable impact on one navy may cause an unacceptable impact on another. For example, most other navies do not possess an integrated strike group and do not have integrated training requirements. The Navy's training is built around the integrated warfare concept and is based on the Navy's capabilities, the threats faced, the operating environment, and the overall mission. Implementing other navies' mitigation would be incompatible with U.S. Navy requirements. The U.S. Navy's recommended mitigation measures have been carefully designed to reduce potential impacts on marine species while not causing an unacceptable impact on readiness.

5.3.4.1.17 Increasing Reporting Requirements

The Navy has extensive reporting requirements, including exercise, testing, and monitoring reporting designed to verify implementation of mitigation, comply with current permits, and improve future environmental assessments (Section 5.5.3, Reporting). Increasing the requirement to report marine species sightings to augment scientific data collection and to further verify the implementation of mitigation measures is unnecessary and would increase safety risks to personnel, be impractical with regard to implementation of military readiness activities, and result in unacceptable impact on readiness for the following reasons:

Vessels, aircraft, and personnel engaged in training and testing events are intensively employed throughout the duration of training and testing activities. Any additional workload assigned that is unrelated to their primary duty would adversely impact personnel safety and the effectiveness of the military readiness activity they are undertaking. Lookouts are not trained to make accurate species-specific identification and would not be able to provide the detailed information that the scientific community would use. Alternatively, the Navy has an integrated comprehensive monitoring program (Section 5.5, Monitoring and Reporting) that does provide information that is available and useful to the scientific community in annual monitoring reports.

5.3.4.2 Previously Accepted but Now Eliminated

5.3.4.2.1 Implementing Active Sonar Ramp-Up Procedures During Testing

Although some testing activities are not capable of ramping up power levels, some have implemented active sonar ramp-up procedures (slowly increasing the sound in the water to necessary levels) in an attempt to clear the range prior to conduct of activities for the purpose of mitigation. Although ramp-up procedures have been used for some testing activities, the effectiveness at avoiding or reducing impacts on marine mammals has not been demonstrated. Until evidence suggests that ramp-up procedures are an effective means of avoiding or reducing potential impacts on marine mammals, and for reasons discussed in Section 5.3.4.1.4 (Implementing Active Sonar Ramp-Up Procedures during Training), the Navy would not implement this measure for testing activities as part of the Proposed Action.

5.3.4.2.2 Implementing a Mitigation Zone for Missile Exercises with Airborne Targets

Per current mitigation, a mitigation zone of 1,000 yd. (920 m) is observed around the expected expended material field. The Navy is proposing to eliminate the need for a Lookout to maintain a mitigation zone for missile exercises involving airborne targets. Most airborne targets are recoverable aerial drones, and missile impact with the target does not typically occur. Most anti-air missiles used in training are telemetry configured (i.e., they do not have an actual warhead). Impact of a target is unlikely because missiles are designed to detonate (simulated detonation for telemetry missiles) in the vicinity of the target and not as a result of a direct strike on the target. Given the speed of the missile and the target, the high altitudes involved, and the long ranges of missile travel possible, it is not possible to definitively predict or to effectively observe where the missile fragments will fall. The potential expended material fall zone can only be predicted within tens of miles for long range events, which can be in excess of 80 nm from the firing location, and thousands of yards for shorter events, which can occur within several thousand yards from the firing location. Establishment of a mitigation zone for activities involving airborne targets would be ineffective at reducing potential impacts.

Furthermore, the potential risk to any marine mammal or sea turtle from a missile exercise with an airborne target is a direct strike from falling expended material. Based on the extremely low potential for a target strike and associated expended material field to co-occur in space and time with a marine species at or near the surface of the water, the potential for a direct strike is negligible.

5.3.4.2.3 Implementing a Mitigation Zone for Medium- and Large-Caliber Gunnery Exercises with Airborne Targets

Per current mitigation, a mitigation zone is observed in the vicinity of the expected military expended material field. The Navy is proposing to eliminate the need for a Lookout to observe the vicinity of the expected military expended material for medium- and large-caliber gunnery exercises involving airborne targets. The potential expended material fall zone can only be predicted within thousands of yards, which can be up to 7 nm from the firing location. Establishment of a mitigation zone for activities involving airborne targets would be ineffective at reducing potential impacts.

Furthermore, the potential risk to any marine mammal or sea turtle from a gunnery exercise with an airborne target is a direct strike from falling military expended materials. Based on the extremely low potential for an expended material field to co-occur in space and time with a marine species at or near the surface of the water, the potential for a direct strike is negligible.

5.4 MITIGATION SUMMARY

Table 5.4-1 provides a summary of the Navy's proposed mitigation measures. For reference, currently implemented mitigation measures for each activity category are also summarized in the table. The process for developing each of these measures is detailed in Section 5.2.3 (Assessment Method) and involved: (1) an effectiveness assessment to determine if implementation of the measure will likely result in avoidance or reduction of an impact on a resource; and (2) an operational assessment to determine if implementation of the measures will have acceptable operational impacts on the Proposed Action with regard to personnel safety, practicality of implementation, readiness, and Navy policy. Measures are intended to meet applicable regulatory compliance requirements for NEPA, Executive Order 12114, and CEQ guidance. The proposed mitigation measures were also developed consistent with resource-specific environmental requirements, as follows:

- Measures specifying marine mammals, floating vegetation (kelp paddies), large schools of fish, or birds as the protection focus are intended to meet MMPA requirements.
- Measures specifying marine mammals, sea turtles, birds, floating vegetation (kelp paddies), or jellyfish aggregations as the protection focus are intended to meet ESA requirements.
- Measures specifying live hardbottom, artificial reefs, or shipwrecks as the protection focus are intended to meet Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act.
- Measures specifying shipwrecks is an additional protection focus intended to meet Abandoned Shipwreck Act and National Historic Preservation Act requirements.

The measures presented in Table 5.4-1 are discussed in greater detail in Section 5.3.1 (Lookout Procedural Measures), Section 5.3.2 (Mitigation Zone Procedural Measures), and Section 5.3.3 (Mitigation Areas). As discussed in Section 5.2.2.2 (Protective Measures Assessment Protocol), the final suite of mitigations resulting from the ongoing planning for this EIS/OEIS, as well as the regulatory consultation and permitting processes will be integrated into the Protective Measures Assessment Protocol for implementation purposes. Section 5.5 (Monitoring and Reporting) describes the monitoring and reporting efforts the Navy will undertake to investigate the effectiveness of implemented mitigation measures and to better understand the impacts of the Proposed Action on marine resources.

Table 5.4-2 compares the current and recommended (proposed) mitigations measures for acoustic (non-impulse and impulse) stressors and for physical disturbance and strike stressors.

Table 5.4-1: Summary of Recommended Mitigation Measures

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Specialized Training			
Marine Species Awareness Training (Modules 1 through 4)	Training: Applicable personnel will complete the United States Navy Marine Species Awareness Training prior to standing watch or serving as a Lookout. Testing: Same as Training	Training: The mitigation zones observed by Lookouts are specified for each Mitigation Zone Procedural Measure below. Testing: Same as Training	Training: Applicable personnel will complete the United States Navy Marine Species Awareness Training prior to standing watch or serving as a Lookout. Testing: Same as Training
Acoustic Stressors – Sonar and Other Active Acoustic Sources			
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar during Anti-Submarine Warfare and Mine Warfare	Training: 2 Lookouts (general), 1 Lookout (minimally manned, moored, or anchored) Testing: 2 Lookouts (general), 1 Lookout (small boats, minimally manned, moored, anchored, pierside, or shore-based)	Training: 1,000 yd. (920 m) and 500 yd. (460 m) power downs and 200 yd. (180 m) shutdown for cetaceans and sea turtles (excludes bow-riding dolphins), 100 yd. (90 m) mitigation zone for pinnipeds (excludes haulouts). Testing: Cetacean mitigation zone 1,000 yd. (920 m), 100 yd. (90 m) for pinnipeds (excludes haulouts), from intended track of the test unit.	Training: 1,000 yd. (920 m) and 500 yd. (460 m) power downs and 200 yd. (180 m) shutdown for marine mammals and sea turtles. Testing: Observation conducted from all participating surface craft and, where available, adjacent shore sites, with a cetacean mitigation zone 1,000 yd. (920 m), 100 yd. (90 m) for pinnipeds from intended track of the test unit.
High-Frequency and Non-Hull-Mounted Mid-Frequency Active Sonar	Training: 2 Lookouts (general), 1 Lookout (minimally manned, moored, or anchored) Testing: 2 Lookouts (general), 1 Lookout (minimally manned, moored, anchored, and aircraft systems testing).	Training: 200 yd. (180 m) for marine mammals and concentrations of floating vegetation. Testing: 200 yd. (180 m) for marine mammals and (100 yd. [90 m] for pinnipeds) from intended track of the test unit (excludes haulouts).	Training: Non-hull-mounted mid-frequency: 200 yd. (180 m) for marine mammals, floating vegetation and kelp paddies. High-frequency: None Sonobuoy Testing: None All Other Testing: Observation conducted from all participating surface craft and, where available, adjacent shore sites, with a cetacean mitigation zone 1,000 yd. (920 m), 100 yd. (90 m) for pinnipeds from intended track of the test unit.
Explosive and Impulse Sound			
Improved Extended Echo Ranging Sonobuoys	Training: 1 Lookout Testing: 1 Lookout	Training: 600 yd. (550 m) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: Same as Training	Training: 1,000 yd. (920 m) for marine mammals and sea turtles. Testing: Same as Training

Table 5.4-1: Summary of Recommended Mitigation Measures (continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Explosive Signal Underwater Sound buoys using 0.6–2.5 lb. NEW	Training: 1 Lookout Testing: 1 Lookout	Training: 350 yd. (320 m) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: Same as Training	None
Mine Countermeasures and Mine Neutralization using Positive Control Firing Devices	Training: 4 Lookouts (2 each on 2 survey boats) Testing: n/a	Training: 700 yd. (640 m) for up to 2.5 lb. charge for marine mammals, turtles, and marbled murrelet. 330 yd. (300 m) for up to 1.5 lb. charge for marbled murrelet. 110 yd. (100 m) for 1 ounce charge marbled murrelet. Testing: n/a	Training: 700 yd. (640 m) for up to 2.5 lb. charge for marine mammals, turtles, and marbled murrelet. 330 yd. (300 m) for up to 1.5 lb. charge for marbled murrelet. 110 yd. (100 m) for 1 ounce charge marbled murrelet. Testing: n/a
Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices	Training: 4 Lookouts (2 each on 2 survey boats) Testing: n/a	Training: 700 yd. (640 m) for up to 2.5 lb. charge for marine mammals, turtles, and marbled murrelet. 330 yd. (300 m) for up to 1.5 lb. charge for marbled murrelet. 110 yd. (100 m) for 1 ounce charge marbled murrelet. Testing: n/a	Training: 700 yd. (640 m) for up to 2.5 lb. charge for marine mammals, turtles, and marbled murrelet. 330 yd. (300 m) for up to 1.5 lb. charge for marbled murrelet. 110 yd. (100 m) for 1-ounce charge marbled murrelet. Testing: n/a
Gunnery Exercises – Small- or Medium-Caliber using a Surface Target	Training: 1 Lookout Testing: n/a	Training: 200 yd. (180 m) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: n/a	Training: 200 yd. (180 m) for marine mammals, sea turtles, and floating vegetation. Testing: n/a
Gunnery Exercises – Large-Caliber Explosive Rounds using a Surface Target	Training: 1 Lookout Testing: n/a	Training: 600 yd. (550 m) around target for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: n/a	Training: None. (Current mitigation measures were for all gunnery exercises and included only a 200 yd. [180 m] mitigation zone, which the Navy feels is too small for high explosive gunnery.) Testing: n/a

Table 5.4-1: Summary of Recommended Mitigation Measures (continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Missile Exercises (Including Rockets) Up to 250 lb. NEW using a Surface Target	Training: 1 Lookout Testing: n/a	Training: 900 yd. (820 m) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: n/a	Training: 1,800 yd. (1.7 km) for marine mammals, sea turtles, floating vegetation and kelp paddies. Testing: n/a
Missile Exercises up to 500 lb. NEW using a Surface Target	Training: 1 Lookout Testing: n/a	Training: 2,000 yd. (1.8 km) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: n/a	Training: 1,800 yd. (1.7 km) for marine mammals, sea turtles, floating vegetation and kelp paddies. Testing: n/a
Explosive and Non-Explosive Bombing Exercises	Training: 1 Lookout Testing: n/a	Training: Explosive: 2,500 yd. (2.3 km) for marine mammals, sea turtles, and concentrations of floating vegetation. Non-Explosive: 1,000 yd. (914 m) for marine mammals, sea turtles, and concentrations of floating vegetation. Testing: n/a	Training: 1,000 yd. (914 m) for marine mammals, sea turtles, floating vegetation and kelp paddies. Testing: n/a
Torpedo (Explosive) Testing	Training: n/a Testing: Surface ship – 2 Lookouts Aircraft – 1 Lookout	Training: n/a Testing: 2,100 yd. (1.9 km) for marine mammals, sea turtles, and concentrations of floating vegetation.	Training: n/a Testing: None
Sinking Exercises	n/a	n/a	4.5 nm for marine mammals, sea turtles, floating vegetation and jellyfish aggregations.
Weapons Firing Noise During Gunnery Exercises – Large-Caliber	Training: 1 Lookout Testing: n/a	Training: 70 yd. (60 m) within 30 degrees on either side of the gun target line on the firing side for marine mammals, sea turtles, and concentrations of floating vegetation.	Training: None Testing: n/a

Table 5.4-1: Summary of Recommended Mitigation Measures (continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Physical Disturbance and Strike			
Vessel Movements	Training: 1 Lookout Testing: 1 Lookout	Training: 500 yd. (460 m) for whales. 200 yd. (183 m) for all other marine mammals (except bow-riding dolphins). Testing: Range craft shall not approach within 100 yd. (90 m) of cetaceans (bow-riding dolphins excluded, and pinnipeds excluded during test body retrieval).	Training: 500 yd. (460 m) for whales. Testing: Range craft shall not approach within 100 yd. (90 m) of marine mammals.
Towed In-Water Device Use	Training: 1 Lookout Testing: 1 Lookout	Training: 250 yd. (229 m) for marine mammals Testing: Range craft shall not approach within 100 yd. (90 m) of marine mammals.	Training: 250 yd. (230 m) for marine mammals. Testing: Range craft shall not approach within 100 yd. (90 m) of marine mammals.

Notes: ft. = feet, km = kilometer, lb.= pound, m = meter, n/a = not applicable, NEW = net explosive weight, nm = nautical mile, yd.= yard

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Table 5.4-2: Mitigation Identification and Implementation

Mitigation Measure	Benefit	Evaluation Criteria	Implementation	Responsible Command	Date Implemented
Marine Species Awareness Training All personnel standing watch on the bridge and Lookouts will successfully complete the training before standing watch or serving as a Lookout.	To learn the procedures for searching for and recognizing the presence of marine species, including detection cues (e.g., congregating seabirds) so that potentially harmful interactions can be avoided.	Successful completion of training by all personnel standing watch and all personnel serving as Lookouts. Personnel successfully applying skills learned during training.	The multimedia training program has been made available to personnel required to take the training. Personnel have been and will continue to be required to take the training prior to standing watch and serving as Lookouts.	Officer Conducting the Exercise or Test or civilian equivalent	Ongoing
Lookouts					
Use of Four Lookouts for Underwater Detonations Mine countermeasure and neutralization activities using time delay or positive control firing devices will include the use of two to four Lookouts, depending on the size of the charge. If applicable, aircrew and divers will report sightings of marine mammals or sea turtles.	Lookouts can visually detect marine species so that potentially harmful impacts to marine mammals and sea turtles from explosives use can be avoided. Lookouts can more quickly and effectively relay sighting information so that corrective action can be taken. Support from aircrew and divers, if they are involved in the activity, will increase the probability of sightings, reducing the potential for impacts.	Annual report documenting NAVSEA testing and marine mammal observation data. Timely reporting of underwater detonations and monitoring results related to bull trout and marbled murrelets.	All Lookouts will receive marine species awareness training and will be positioned on vessels, boats, and aircraft as described in Section 5.3.1.1.1 (Training for Personnel Standing Watch and Lookouts).	Officer Conducting the Exercise or Test	Ongoing
Use of One or Two Lookouts Vessels using low-frequency active sonar or hull-mounted mid-frequency active sonar associated with ASW activities will have either one or two Lookouts, depending on the activity and size of the vessel. Mine countermeasure and neutralization activities with positive control will use two Lookouts, with one on each support vessel. If applicable, aircrew and divers will also report the presence of marine mammals or sea turtles. One Lookout may be used under certain circumstances specific in Section 5.3.1.2 (Lookouts).	Lookouts can visually detect marine species so that potentially harmful impacts to marine mammals and sea turtles from Navy sonar and explosives use can be avoided. Lookouts can more quickly and effectively relay sighting information so that corrective action can be taken. Support from aircrew and divers, if they are involved in the activity, will increase the probability of sightings, reducing the potential for impacts.				
Use of One Lookout Surface ships and aircraft conducting ASW, ASUW, or MIW activities using HFAS, non-hull-mounted mid-frequency active sonar, helicopter dipping mid-frequency active sonar, anti-swimmer grenades, explosive buoys, surface gunnery activities, surface missile activities, bombing activities, explosive torpedo testing, and activities using non-explosive practice munitions, will have one Lookout.	Lookouts can visually detect marine species so that potentially harmful impacts to marine mammals and sea turtles from Navy sonar, explosives, sonobuoys, gunnery rounds, missiles, explosive torpedoes, pile driving, towed systems, surface vessel propulsion, and non-explosive munitions can be avoided. Lookouts will quickly and effectively relay sighting information so that corrective action(s) can be taken.				

Table 5.4-2: Mitigation Identification and Implementation (continued)

Mitigation Measure	Benefit	Evaluation Criteria	Implementation	Responsible Command	Date Implemented
Mitigation Zones					
Use of a Mitigation Zone A mitigation zone is an area defined by a radius and centered on the location of a sound source or activity. The size of each mitigation zone is specific to a particular training or testing activity (e.g., sonar use or explosive use).	A mitigation zone defines the area in which Lookouts survey for marine mammals and sea turtles. Mitigation zones reduce the potential for injury to marine species.	For those activities where monitoring is required, record observations of marine mammals and sea turtles located outside of the mitigation zone and note any apparent reactions to on-going Navy activities. Observation of acute reactions may be used as an indicator that the radius of the mitigation zone needs to be increased.	Mitigation zones have been and will continue to be implemented as described in Section 5.3.2 (Mitigation Zone Procedural Measures). Lookouts are trained to conduct observations within mitigation zones of different sizes.	Officer Conducting the Exercise or Test	Ongoing
Recognize the Importance of Marine Protected Areas In general, most Armed Forces activities are exempt from the prohibitions of marine protected areas Nevertheless, the Navy would carry out its training and testing activities in a manner that will avoid, to the maximum extent practical and consistent with training and testing requirements, adverse impacts to National Marine Sanctuary resources.	Avoiding or minimizing impacts while operating in or near marine protected areas could result in improved health of the resources in the areas.	The Navy shall submit an annual report to the National Marine Fisheries Service.	The Navy includes charts in the Protective Measures Assessment Protocol to define marine protected areas. To the greatest extent practical, adverse impacts to these areas will be avoided.	Officer Conducting the Exercise or Test	Ongoing

Notes: ASW = Anti-submarine Warfare, ASUW = Anti-surface Warfare, HFAS = High-Frequency Active Sonar, IEER = Improved Extended Echo Ranging, MIW = Mine Warfare, NAVSEA = Naval Sea Systems Command

5.5 MONITORING AND REPORTING

5.5.1 APPROACH TO MONITORING

The Navy is committed to demonstrating environmental stewardship while executing its National Defense Mission and complying with the suite of Federal environmental laws and regulations. As a complement to the Navy's commitment to avoiding and reducing impacts of the Proposed Action through mitigation, the Navy will undertake monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the effects of the Proposed Action on marine resources. Taken together, mitigation and monitoring comprise the Navy's integrated approach for reducing environmental impacts from the Proposed Action. The Navy's overall monitoring approach will seek to leverage and build on existing research efforts whenever possible.

Consistent with the cooperating agency agreement with NMFS, mitigation and monitoring measures presented in this EIS/OEIS focus on the requirements for protection and management of marine resources. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management of marine resources. Since monitoring will be required for compliance with the final rule issued for the Proposed Action under the MMPA, details of the monitoring program will be developed in coordination with NMFS through the regulatory process. Discussions with resource agencies during the consultation and permitting processes may result in changes to the mitigation as described in this document. Such changes will be reflected in the Final EIS/OEIS, ROD, and consultation documents such as the ESA Biological Opinion.

5.5.1.1 Integrated Comprehensive Monitoring Plan Top-Level Goals

The Integrated Comprehensive Monitoring Program is intended to coordinate monitoring efforts across all regions where the Navy trains and tests and to allocate the most appropriate level and type of effort for each range complex (U.S. Department of the Navy 2010). The current Navy monitoring program is composed of a collection of "range-specific" monitoring plans, each developed individually as part of MMPA and ESA compliance processes as environmental documentation was completed. These individual plans establish specific monitoring requirements for each range complex and are collectively intended to address the Integrated Comprehensive Monitoring Program top-level goals.

A 2010 Navy-sponsored monitoring meeting in Arlington, Virginia, initiated a process to critically evaluate the current Navy monitoring plans and begin development of revisions and updates to both existing region-specific plans as well as the Integrated Comprehensive Monitoring Plan. Discussions at that meeting as well as the following Navy and NMFS annual adaptive management meeting established a way ahead for continued refinement of the Navy's monitoring program. This process included establishing a Scientific Advisory Group of leading marine mammal scientists with the initial task of developing recommendations that would serve as the basis for a Strategic Plan for Navy monitoring. The Strategic Plan is intended to be a primary component of the Integrated Comprehensive Monitoring Program, provide a "vision" for Navy monitoring across geographic regions—serving as guidance for determining how to most efficiently and effectively invest the marine species monitoring resources to address Integrated Comprehensive Monitoring Program top-level goals, and satisfy MMPA Letter of Authorization regulatory requirements.

The objective of the Strategic Plan is to continue the evolution of Navy marine species monitoring towards a single integrated program, incorporating Scientific Advisory Group recommendations, and establishing a more transparent framework for soliciting, evaluation, and implementing monitoring work

across the range complexes. The Strategic Plan must consider a range of factors in addition to the scientific recommendations including logistic, operational, and funding considerations and will be revised regularly as part of the annual adaptive management process.

The Integrated Comprehensive Monitoring Plan establishes top-level goals that have been developed in coordination with NMFS (U.S. Department of the Navy 2010). The following top-level goals will become more specific with regard to identifying potential projects and monitoring field work through the Strategic Plan process as projects are evaluated and initiated in the Study Area.

- An increase in our understanding of the likely occurrence of marine mammals or ESA-listed marine species in the vicinity of the action (i.e., presence, abundance, distribution, and density of species);
- An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammals and ESA-listed species to any of the potential stressor(s) associated with the action (e.g., tonal and impulse sound), through better understanding of one or more of the following: (1) the action and the environment in which it occurs (e.g., sound source characterization, propagation, and ambient noise levels), (2) the affected species (e.g., life history or dive patterns), (3) the likely co-occurrence of marine mammals and ESA-listed marine species with the action (in whole or part) associated with specific adverse effects, or (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and ESA-listed marine species (e.g., age class of exposed animals or known pupping, calving or feeding areas);
- An increase in our understanding of how individual marine mammals or ESA-listed marine species respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level);
- An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) the long-term fitness and survival of an individual; or (2) the population, species, or stock (e.g., through effects on annual rates of recruitment or survival);
- An increase in our understanding of the effectiveness of mitigation and monitoring measures;
- A better understanding and record of the manner in which the authorized entity complies with the Incidental Take Authorization and Incidental Take Statement;
- An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals; and
- A reduction in the adverse impact of activities to the least practicable level, as defined in the MMPA.

5.5.1.2 Scientific Advisory Group Recommendations

Navy established the Scientific Advisory Group in 2011 with the initial task of evaluating current Navy monitoring approaches under the Integrated Comprehensive Monitoring Plan and existing MMPA Letters of Authorization and developing objective scientific recommendations that would form the basis for this Strategic Plan. While recommendations were fairly broad and not prescriptive from a range complex perspective, the Scientific Advisory Group did provide specific programmatic recommendations that serve as guiding principles for the continued evolution of the Navy Marine Species Monitoring Program and provide a direction for the Strategic Plan to move this development. Key recommendations include:

- Working within a conceptual framework of knowledge, from basic information on the occurrence of species within each range complex, to more specific matters of exposure, response, and consequences.
- Facilitating collaboration among researchers in each region, with the intent to develop a coherent and synergistic regional monitoring and research effort.
- Striving to move away from a "box-checking" mentality. Monitoring studies should be designed and conducted according to scientific objectives, rather than on merely cataloging effort expended.
- Approach the monitoring program holistically and select projects that offer the best opportunity to advance understanding of the issues, as opposed to establishing range-specific requirements.

5.5.2 ACTIVITY SPECIFIC MONITORING

Mine Countermeasures and Neutralization Training Activities

Following consultation with USFWS, the Navy has implemented the monitoring measures necessary to minimize the impact of the taking on both bull trout and marbled murrelets during Mine Countermeasures and Neutralization Activities.

Bull Trout

In October 2012, in cooperation with USFWS, the Navy completed a post-detonation fish-monitoring plan to be implemented after each Explosive Ordnance Disposal (EOD) detonation in Crescent Harbor. The monitoring plan ensures that mortality of bull trout that may occur from EOD detonations does not exceed the amount anticipated in this incidental take statement (10 adult or subadult bull trout over 5 years).

Marbled Murrelet

In October 2012, the Navy completed a monitoring plan it developed in cooperation with USFWS. The monitoring plan addresses the following objectives:

- Ensures the SPL for each detonation associated with EOD exercises is less than 41 pascal seconds (pa Sec) at 210 m for 2.5 lb charges and 150 m for 1.5 lb charges.
- Measure transmission loss (decay) of underwater sound beyond 210 m and 150 m distances on a mutually agreeable number of detonations.
- Monitor murrelet (or an appropriate surrogate) response to exposure to underwater sound beyond 210 m and 150 m distances.

Testing Activities in the Inland Waters

The following monitoring measures apply to testing activities conducted in the Inland Waters.

Marbled Murrelet

The Navy is proposing to eliminate marbled murrelet monitoring and reporting for testing activities in Inland Waters. There is no evidence to support that marbled murrelet hearing is within the frequency ranges of the sound sources used in these tests. Therefore, previously required monitoring and reporting related to testing activities would provide no added benefit. The Navy is currently in consultation with USFWS on this and other issues related to potential impacts to the marbled murrelet.

5.5.3 REPORTING

The Navy is committed to documenting and reporting relevant aspects of training and testing activities in order to document species sightings, reduce environmental impact, and improve future environmental assessments, including the reporting initiatives described below.

5.5.3.1 Exercise and Monitoring Reporting

The Navy will submit annual exercise and monitoring reports to the Office of Protected Resources at NMFS. The exercise report will describe the level of training and testing conducted during the reporting period, and the monitoring report will describe both the nature of the monitoring that has been conducted and the actual results of the monitoring. All of the details regarding the content of the annual reports will be coordinated with NMFS through the permitting process. All unclassified reports submitted to date can be found on the NMFS Office of Protected Resources webpage.

5.5.3.2 Additional Reporting Requirements

5.5.3.2.1 Marine Mammal or Sea Turtle

If there is evidence that a marine mammal or sea turtle may have been stranded, injured or killed by the action, Navy training and testing activities will be immediately suspended and the situation immediately reported by the participating unit to the Officer in Charge of the Exercise, who will follow Navy procedures for reporting the incident to Commander, Pacific Fleet, Commander, Navy Region Northwest, Environmental Director, and the chain-of-command. The situation will also be reported to NMFS.

Navy personnel shall ensure that NMFS is notified immediately (or as soon as clearance procedures allow) if an injured, stranded, or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing mid-frequency active sonar, high-frequency active sonar, or underwater explosive detonations. The Navy will provide NMFS with the name of species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). In the event that an injured, stranded, or dead marine mammal is found by the Navy that is not in the vicinity of, or during or shortly after, mid-frequency active sonar, high-frequency active sonar, or underwater explosive detonations, the Navy will report the same information as listed above as soon as operationally feasible and clearance procedures allow.

General Notification of Ship Strike

In the event of a ship strike by any Navy vessel, at any time or place, the Navy shall do the following:

- Immediately report to NMFS the species identification (if known), location (lat/long) of the animal (or the strike if the animal has disappeared), and whether the animal is alive or dead (or unknown).
- Report to NMFS as soon as operationally feasible the size and length of animal, an estimate of the injury status (e.g., dead, injured but alive, injured and moving, unknown, etc.), vessel class/type and operational status.
- Report to NMFS the vessel length, speed, and heading as soon as feasible.
- Provide NMFS a photo or video, if equipment is available.

5.5.3.2.2 Bull Trout

Within 30 days after each underwater detonation (for Mine Countermeasures and Neutralization), the Navy shall submit a report to the USFWS detailing the results of the monitoring. Each report shall address the following, at a minimum:

- Dates and times of all detonations (underwater and floating mine);
- Location within training area and water depth for each detonation; and
- The results of fish monitoring, to include the number, location, and physical condition of all bull trout observed.

Any bull trout recovered after the detonation will be immediately frozen and submitted to USFWS or directly to an agreed upon laboratory for necropsy. The cost of the necropsy will be borne by the Navy, and results will be provided as soon as possible to the USFWS.

5.5.3.2.3 Marbled Murrelet

Within 30 days after each detonation, the Navy shall submit a report to the USFWS detailing the results of the monitoring. Each report shall address the following, at a minimum:

- Dates and times of all detonations (underwater and floating mine);
- Location within training area and water depth for each detonation;
- Sound levels generated during an underwater detonation at various distances from the detonation site, as specified in the monitoring plan (This analysis may be submitted on a timeline agreed to in the monitoring plan to be developed); and
- Murrelet response (or surrogate response) to underwater sound at levels less than 41 pa Sec (or distances of 210 m [Crescent Harbor] and 150 m [Hood Canal], respectively).

Testing Activities in the Inland Waters

The following reporting requirements apply to testing activities conducted in the Inland Waters.

Marbled Murrelet

The Navy is proposing to eliminate marbled murrelet reporting for testing activities in Inland Waters. There is no evidence to support that marbled murrelet hearing is within the frequency ranges of the sound sources used in these tests. Therefore, previously required reporting related to testing activities would provide no added benefit. The Navy is currently in consultation with USFWS on this and other issues related to potential impacts to the marbled murrelet.

5.5.3.3 Stranding Response Plan

In coordination with NMFS, the Navy will have a stranding response plan. All of the details regarding the content of the stranding response plan will be coordinated with NMFS through the permitting process.

5.5.3.4 Bird Strikes

The Navy will report all damaging and non-damaging bird strikes to the Naval Safety Center through the chain of command.

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6 Additional Regulatory Considerations

TABLE OF CONTENTS

6 ADDITIONAL REGULATORY CONSIDERATIONS 6-1

6.1 CONSISTENCY WITH OTHER APPLICABLE FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND REGULATIONS 6-1
6.1.1 COASTAL ZONE MANAGEMENT ACT COMPLIANCE 6-7
6.1.1.1 Washington Coastal Zone Management Program.....6-8
6.1.1.2 Oregon Coastal Management Program 6-8
6.1.1.3 California Coastal Management Program.....6-9
6.1.1.4 Alaska Coastal Management Program.....6-9
6.1.2 MARINE PROTECTED AREAS 6-9
6.2 RELATIONSHIP BETWEEN SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY 6-27
6.3 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES 6-27
6.4 ENERGY REQUIREMENTS AND CONSERVATION POTENTIAL OF ALTERNATIVES AND MITIGATION MEASURES 6-28

LIST OF TABLES

TABLE 6.1-1: SUMMARY OF ENVIRONMENTAL COMPLIANCE FOR THE PROPOSED ACTION 6-2
TABLE 6.1-2: MARINE PROTECTED AREAS WITHIN THE NORTHWEST TRAINING AND TESTING STUDY AREA..... 6-13

LIST OF FIGURES

FIGURE 6.1-1: MAP OF MARINE PROTECTED AREAS IN THE STUDY AREA 6-12

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6 ADDITIONAL REGULATORY CONSIDERATIONS

In accordance with the Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA), federal agencies shall, to the fullest extent possible, integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively. This chapter summarizes environmental compliance for the Proposed Action; consistency with other federal, state, and local plans, policies, and regulations; the relationship between short-term use of the environment and maintenance and enhancement of long-term productivity in the affected environment; irreversible or irretrievable commitments of resources; and energy requirements and conservation.

6.1 Consistency with Other Applicable Federal, State, and Local Plans, Policies, and Regulations

Implementation of the Proposed Action addressed in the Northwest Training and Testing (NWTT) Environmental Impact Statement (EIS)/Overseas EIS (OEIS) would comply with applicable federal, state, and local laws, regulations, and executive orders. The United States (U.S.) Department of the Navy (Navy) is consulting with and will continue to consult with regulatory agencies, as appropriate, during the NEPA process and prior to implementation of the Proposed Action to ensure that requirements are met. Table 6.1-1 summarizes environmental compliance requirements that were considered in preparing this EIS/OEIS (including those that may be secondary considerations in the resource evaluations). Section 3.0.1 (Regulatory Framework) provides brief excerpts of the primary federal statutes, executive orders, international standards, and guidance that form the regulatory framework for the resource evaluations. Documentation of consultation and coordination with regulatory agencies is provided in Appendix C (Agency Correspondence). Formal consultation under the Endangered Species Act (ESA) will start following the release of the Draft EIS/OEIS. However, the Navy has been coordinating with regulatory offices prior to initiating the formal consultation. Likewise, the Navy submitted applications to the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act authorizations supported by this EIS/OEIS. Consultation with NMFS is currently underway. Therefore, not all consultation documentation is included in Appendix C (Agency Correspondence) or on the website (https://nwtteis.com/) at this time, but all compliance will be completed prior to the signing of the Record of Decision for the Proposed Action.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws	
Abandoned Shipwreck Act (43 U.S.C. §§ 2101–2106)	The 1987 Abandoned Shipwreck Act establishes requirements for educational and recreational access to abandoned shipwrecks, the protection of such resources through the establishment of underwater parks and protected areas, the development of specific guidelines for management and protection in consultation with various stakeholders, defines the jurisdiction and responsibility of federal and state agencies, and explicitly states that the law of salvage and the law of finds do not apply. Under the Act, the Department of the Interior and National Park Service issued guidelines in 2007 to help states manage shipwrecks in their waters. The Act defines the federal government's title to any abandoned shipwreck that meets criteria for inclusion in the National Register of Historic Places within state submerged lands, with the stipulation that title to these shipwrecks will be transferred to the appropriate state. For abandoned shipwrecks in U.S. Territorial Waters, the federal government asserts title to the resource. See Section 3.10 (Cultural Resources) for assessment and conclusion that the Proposed Action is consistent with the Act.
Act to Prevent Pollution from Ships (33 U.S.C. § 1901 et seq.)	Requirements associated with the Act to Prevent Pollution from Ships are implemented by the Navy Environmental Readiness Program Manual and related Navy guidance documents governing waste management, pollution prevention, and recycling. At sea, the Navy complies with these regulations and operates in a manner that minimizes or eliminates any adverse effects on the marine environment (U.S. Department of the Navy 2007). See Section 3.1 (Sediments and Water Quality) for the assessment.
Antiquities Act (16 U.S.C. § 431)	The Antiquities Act states that any person who shall appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States, without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, shall, upon conviction, be fined or be imprisoned for a period of not more than 90 days, or shall suffer both fine and imprisonment. The Proposed Action is consistent with the Act's objectives for protection of archaeological and historical sites and objects, preservation of cultural resources, and the public's access to them. See Section 3.10 (Cultural Resources) for the assessment.
Bald and Golden Eagle Protection Act (16 U.S.C. 668–668c)	This Act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. Implementation of the Proposed Action would not result in an adverse effect on Bald or Golden Eagles as their protection is defined in the Bald and Golden Eagle Protection Act. The Bald and Golden Eagle Protection Act is discussed in detail in regards to the Proposed Action in Section 3.6 (Birds).
Coastal Zone Management Act (16 C.F.R. § 1451 et seq.)	This Act established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. The Navy is evaluating the Proposed Action to determine whether it will affect the coastal uses or resources of any of the four states in the Study Area. See Section 6.1.1, below, for discussion of Navy activities and compliance with the Coastal Zone Management Act.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws (continued)	
Clean Air Act (CAA) (42 U.S.C. §§ 7401 et seq.) CAA General Conformity Rule (40 C.F.R. § 93[B]) State Implementation Plan (SIP)	The CAA is the comprehensive federal law that regulates air emissions from stationary and mobile sources. The Proposed Action would not conflict with attainment and maintenance goals established in SIPs. A CAA conformity determination will not be required because emissions attributable to the alternatives including the Proposed Action would be below *de minimis* thresholds. However, a Record of Non-Applicability will be completed for the actions that occur at Naval Station Everett.
Clean Water Act (CWA) (33 U.S.C. 1251 et seq.)	The CWA is an act to provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency, and for other purposes. The Act's objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The Proposed Action would not conflict with goals established in SIPs. No permits are required under the CWA Sections 401, 402, or 404 (b) (1).
Endangered Species Act (ESA) (16 U.S.C. §§ 1531 et seq.)	The ESA established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. The EIS/OEIS analyzes potential effects to species listed under the ESA. In accordance with ESA requirements, the Navy will complete consultation under Section 7 of the ESA with NMFS and USFWS on the potential that implementation of the Proposed Action may affect listed species. With regard to NMFS jurisdiction, upon concluding Section 7 consultation, the Navy will adhere to any Biological Opinion (BO). In addition, the Navy has applied for a Letter of Authorization (LOA) (see discussion below re: Marine Mammal Protection Act), which is expected to impose terms and conditions that, when implemented, would make ESA Section 9 prohibitions inapplicable to covered Navy activities. With regard to USFWS jurisdiction over species present in the Study Area, the Navy will adhere to the terms of the BOs.
Historic Sites Act (16 U.S.C. §§ 461–467)	The Historic Sites Act established a national policy to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States. The Proposed Action is consistent with the national policy for the preservation of historic sites, buildings, and objects of national significance. See Section 3.10 (Cultural Resources) for the complete assessment.
Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801–1802)	The Magnuson-Stevens Fishery Conservation and Management Act was established to conserve and manage U.S. fishery resources. The Proposed Action has the potential to adversely affect essential fish habitat and managed species. The Navy is preparing an Essential Fish Habitat Assessment and, if required, will consult with NMFS on affected species and their habitats.
Marine Mammal Protection Act (MMPA) (16 U.S.C. §§ 1431 et seq.)	The MMPA governs activities with the potential to harm, disturb, or otherwise "harass" marine mammals. As a result of acoustic effects associated with active sonar use, acoustic sources, and underwater detonations of explosives, implementation of the alternatives including the Proposed Action may result in potential Level A (harm or mortality) or Level B (disturbance) harassment to marine mammals. Therefore, the Navy engaged in the NMFS regulatory process by conducting the analysis in Chapter 3 to determine whether incidental "takes" of marine mammals are likely, and will seek to obtain LOAs from NMFS as appropriate.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Laws (continued)	
Migratory Bird Treaty Act (16 U.S.C. §§ 703–712)	The Migratory Bird Treaty Act prohibits the taking, killing, or possessing of migratory birds or the parts, nests, or eggs of such birds, unless permitted by regulation. The 2003 National Defense Authorization Act provides that the Armed Forces may take migratory birds incidental to military readiness activities provided that, for those ongoing or proposed activities that the Armed Forces determine may result in a significant adverse effect on a population of a migratory bird species, the Armed Forces confer and cooperate with the Service to develop and implement appropriate conservation measures to minimize or mitigate such significant adverse effects. Implementation of the Proposed Action would cause no significant adverse effect on a population of migratory bird species. See Section 3.6 (Birds) for the assessment.
Resource Conservation and Recovery Act (42 U.S.C. § 6901 et seq.)	Under the Resource Conservation and Recovery Act, the Military Munitions Rule identifies when conventional and chemical military munitions are considered solid waste. Military munitions are not considered solid waste if they are (1) used for their intended purpose, which includes training military personnel and testing of munitions, weapons, or weapon systems; or (2) subjected to materials recovery activities (40 Code of Federal Regulations [C.F.R.] § 266.202(a)(1) and (2)). These two conditions cover the uses of munitions included in the Proposed Action; therefore, the Resource Conservation and Recovery Act does not apply.
National Fishery Enhancement Act (33 U.S.C. § 2101 et seq.)	The purpose of this act is to promote and facilitate responsible and effective efforts to establish artificial reefs in the navigable waters of the United States and the waters superjacent to the Outer Continental Shelf. The Proposed Action is consistent with regulations administered by NMFS and U.S. Army Corps of Engineers concerning artificial reefs because the Proposed Action does not include the establishment of artificial reefs.
National Historic Preservation Act (16 U.S.C. §§ 470 et seq.)	The alternatives, including the Proposed Action, will be implemented and a letter of notification will be sent to the State Historic Preservation Office. No programmatic agreement will occur, as there is no impact on Historic resources because of the proposed action..
National Marine Sanctuaries Act (16 U.S.C. § 1431 et seq.)	This Act authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as National Marine Sanctuaries. One National Marine Sanctuary administered by the National Oceanic and Atmospheric Administration Office of National Marine Sanctuaries lies within the Study Area, which is discussed in Section 6.1.2.1.1 for assessment.
Rivers and Harbors Act (33 U.S.C. § 401 et seq.)	The Rivers and Harbors Act addresses projects and activities in navigable waters and harbor and river improvements. In accordance with U.S. Army Corps of Engineers regulations, no permit is required under the Rivers and Harbors Act because no construction in navigable waterways is proposed.
Submerged Lands Act of 1953 (43 U.S.C. §§ 1301–1315)	The Submerged Lands Act returns the title to submerged lands to the states and promotes the exploration and development of petroleum deposits in coastal waters. The Proposed Action is consistent with regulations concerning the Submerged Lands Act.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Executive Orders (continued)	
Sunken Military Craft Act (Public Law 108-375, 10 U.S.C. § 113 Note and 118 Stat. 2094-2098)	Under this Act, no person shall engage in or attempt to engage in any activity directed at a sunken military craft that disturbs, removes, or injures any sunken military craft. The Proposed Action would have no adverse effects on sunken U.S. military ships and aircraft within the Study Area. If a site is determined to be eligible for the National Register of Historic Places, the State Historic Preservation Officer would be consulted to address potential effects. See Section 3.10 (Cultural Resources) for the assessment.
California Marine Life Protection Act and Marine Managed Areas Improvement Act (California Fish and Game Code §§ 2850–2863)	California Marine Life Protection Act requires California Department of Fish and Game to confer with the Navy regarding issues related to Navy activities that may affect Marine Managed Areas. Because the portion of the Study Area near California is 12 nm off the coast, activities will occur outside of the State's jurisdiction, and therefore, no impacts are expected nor is consultation required.
Executive Order 11990*, Protection of Wetlands*	This EO was issued to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands. There are no wetlands within the Study Area; therefore, the EO does not apply to the Proposed Action.
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*	This EO is responsible for identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. The proposed activities occurring in the Inland Waters of Washington and Alaska, and open ocean should not have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. See Section 3.0.5.3 (Identification of Stressors for Analysis) for the assessment.
Executive Order 12962*, Recreational Fisheries*	This EO orders Federal agencies, to the extent permitted by law and where practicable, and in cooperation with States and Tribes, to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing. The Proposed Action would not affect federal agencies' ability to fulfill certain duties with regard to promoting the health and access of the public to recreational fishing areas. See Section 3.12 (Socioeconomics) for the assessment.
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*	This EO considers the risks that arise because children eat more food, drink more fluids, and breathe more air in proportion to their body weight than adults; children's size and weight may diminish their protection from standard safety features; and children's behavior patterns may make them more susceptible to accidents because they are less able to protect themselves. Although children could be present in vessels on the water, there are no sensitive receptors as defined by the EO present in the Study Area and, therefore, the Proposed Action would not result in disproportionate environmental health risks or safety risks to children. See Section 3.0.5.3 (Identification of Stressors for Analysis) for the assessment.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Executive Orders (continued)	
Executive Order 13089*, Coral Reef Protection*	EO 13089 was enacted to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment. The Navy has prepared this EIS/OEIS in accordance with requirements that federal agencies whose actions affect U.S. coral reef ecosystems shall provide for implementation of measures needed to research, monitor, manage, and restore them, including reducing impacts from pollution and sedimentation. See Section 3.3 (Marine Habitats) and Section 3.8 (Marine Invertebrates) for assessment.
Executive Order 13112*, Invasive Species*	This EO is to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. The Proposed Action would not increase the number of or introduce new invasive species nor require the Navy to take measures to avoid introduction and spread of those species. Naval vessels are exempt from 33 C.F.R. 151 Subpart D, Ballast Water Management for Control of Nonindigenous Species in Waters of the United States.
Executive Order 13158, *Marine Protected Areas*	This EO is intended to provide for the protection of significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of MPAs. The Navy has prepared this EIS/OEIS in accordance with the requirements to avoid harm to the natural and cultural resources of existing national system marine protected areas. See Section 6.1.2 for more information.
Executive Order 13175, *Consultation and Coordination With Indian Tribal Governments*	This order is to establish a regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes. The Proposed Action is consistent with the comprehensive national policy for the Consultation and Coordination with Indian Tribal Governments.
Executive Order 13514*, Federal Leadership in Environmental, Energy, and Economic Performance*	This EO is to establish an integrated strategy toward sustainability in the Federal Government and to make reduction of greenhouse gas emissions a priority for Federal agencies. The Proposed Action is consistent with the integrated strategy toward sustainability in the federal government and to making reduction of greenhouse gas emissions a priority for federal agencies.
Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*	This order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests. The Proposed Action is consistent with the comprehensive national policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
International Standards	
International Convention for the Prevention of Pollution from Ships	This standard prohibits certain discharges of oil, garbage, and other substances from vessels. The convention and its annexes are implemented by national legislation, including the Act to Prevent Pollution from Ships (33 U.S.C. §§ 1901–1915) and the Federal Water Pollution Control Act (33 U.S.C. §§ 1321–1322). The Proposed Action does not include vessel operation and discharge from ships; however, the Navy vessels operating in the Study Area would comply with the discharge requirements established in this program, minimizing or eliminating potential impacts from discharges from ships.

Notes: CAA = Clean Air Act, C.F.R. = Code of Federal Regulations, CZMA = Coastal Zone Management Act, EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, EO = Executive Order, MPA = Marine Protected Area, Navy = United States Department of the Navy, nm = nautical mile, NMFS = National Marine Fisheries Service, NWTRC = Northwest Training Range Complex, U.S. = United States, U.S.C. = United States Code

6.1.1 COASTAL ZONE MANAGEMENT ACT COMPLIANCE

The Coastal Zone Management Act (CZMA) of 1972 (16 U.S. Code [U.S.C.] § 1451, et seq.) encourages coastal states to be proactive in managing coastal zone uses and resources. The Act established a voluntary coastal planning program under which participating states submit a Coastal Management Plan (CMP) to the National Oceanic and Atmospheric Administration (NOAA) for approval. Under the Act, federal actions that have an effect on a coastal use or resource are required to be consistent, to the maximum extent practicable, with the enforceable policies of federally approved CMPs.

The Act defines the coastal zone as extending “to the outer limit of State title and ownership under the Submerged Lands Act” (i.e., 3 nautical miles [nm]). The extent of the coastal zone inland varies from state to state, but the shoreward extent is not relevant to this Proposed Action. The CZMA federal consistency determination process includes a review of the Proposed Action to determine whether it has reasonably foreseeable effects on coastal zone resources or uses, an in-depth examination of any such effects, and a determination on whether those effects are consistent to the maximum extent practicable with the State's enforceable policies. Under the CZMA, the states must provide an opportunity for public comment and involvement in the federal coastal consistency determination process.

A Consistency Determination, or a Negative Determination, may be submitted for review of federal agency activities. A federal agency submits a consistency determination when it determines that its activity may have either a direct or an indirect effect on a state coastal use or resource. In accordance with 15 Code of Federal Regulations (C.F.R.) § 930.39, the consistency determination will include a brief statement indicating whether the proposed activity will be undertaken in a manner consistent to the maximum extent practicable with the enforceable policies of the management program. The consistency determination should be based on evaluation of the relevant enforceable policies of the management program. In accordance with 15 C.F.R. § 930.35, “if a Federal agency determines that there will not be coastal effects, then the Federal agency shall provide the State agencies with a negative determination for a Federal agency activity: (1) Identified by a State agency on its list, as described in § 930.34(b), or through case-by-case monitoring of unlisted activities; or (2) Which is the same as or is similar to activities for which consistency determinations have been prepared in the past; or (3) For which the Federal agency undertook a thorough consistency assessment and developed initial findings on the

coastal effects of the activity." Thus, a negative determination must be submitted to a state if the agency determines no coastal effects and one or more of the triggers above is met.

6.1.1.1 Washington Coastal Zone Management Program

The state of Washington's Coastal Zone Management Program (CZMP) was the first to be approved in 1976. The Washington CZMP is implemented by Washington Department of Ecology (DOE) and approved by NOAA. Washington's CZMP is primarily based on their Shoreline Management Act of 1971, as well as other state land use and resource management laws. Any public federal project carried out with a federal agency, or private project licensed or permitted by a federal agency, or carried out with a federal grant, must be determined to have "Federal Consistency," which means the project is consistent with Washington's CZMP.

The coastal zone includes all lands and waters from the coastline seaward to 3 nm. The coastline along the inland marine waters is located at the seaward limit of rivers, bays, estuaries, or sound. The inland political boundaries of the counties are used as the Coastal Zone limit because they generally follow drainage divides. The Act specifically excludes from the coastal zone those lands that are subject solely by law to the discretion of or held in trust by the federal government (i.e., military reservations and other defense installations, all lands within National Parks, Indian lands held in trust by the federal government, and National Forest lands and National Recreation Areas owned or leased by the federal government) (National Oceanic and Atmospheric Administration 2001).

The federal CZMA also gives special funding to assist in making improvements to the state CZMP. Washington State participates in these voluntary Improvement Grants, otherwise known as the Section 309 Program, in order to update and amend the Shoreline Master Program Guidelines under Washington's Shoreline Management Act.

As a component of the Proposed Action, the Navy initiated a Federal consistency process under the CZMA with the Washington DOE. The Navy will submit its consistency determination to the Washington DOE in compliance with the CZMP.

6.1.1.2 Oregon Coastal Management Program

The state of Oregon has an approved CMP, administered by the Department of Land Conservation and Development. The Oregon Coastal Management Program (OCMP) knits together various state statutes for managing coastal lands and waters into a single, coordinated package. There are three basic parts of the program: the 19 Statewide Planning Goals, City and County Comprehensive Land Use Plans, and State Agencies and Natural Resource Laws. The Program coordinates and integrates programs of local, state, and federal agencies to support local planning and to protect and restore coastal natural resources. The Oregon Coastal Zone extends from the Washington border on the north to the California border on the south, seaward to 3 nm offshore, and inland to the crest of the coastal mountain range (except to the downstream end of Puget Island on the Columbia River), to Scottsburg on the Umpqua River, and to Agness on the Rogue River.

Under the CZMA, the OCMP provides guidelines and financial and technical assistance for coastal grants, public notices, shoreland processes, water quality, ocean resources, territorial sea plans, coastal access, coastal planners network meetings, public involvement, and local government partners.

As a component of the Proposed Action, the Navy initiated a federal consistency process under the CZMA with the Oregon Department of Land Conservation and Development (DLCD). Previously, the

Navy submitted a negative determination to the Oregon DLCD for the Northwest Training Range Complex (NWTRC) EIS. The proposed actions for the NWTT EIS and the NWTRC EIS are similar within the Oregon coastal zone, the only difference being that the Study Area in the NWTT EIS starts at 12 nm from the coast, while the NWTRC EIS Study Area had a small portion of the Pacific Northwest Operating Area (OPAREA) located from 0 to 3 nm off the Oregon Coast. Therefore, the Navy will again be submitting a negative determination, as the NWTT Study Area stops 12 nm short of the coastline and is well outside of the 3 nm coastal zone limit, and the proposed activities will have no effect on the coastal zone.

6.1.1.3 California Coastal Management Program

The state of California has an approved CMP, administered by the California Coastal Commission (CCC). The California Coastal Act of 1976 (California Public Resources Code, § 30000 et seq.) implements California's CMP. The California Coastal Act includes policies to protect and expand public access to shorelines, and to protect, enhance, and restore environmentally sensitive habitats, including intertidal and nearshore waters, wetlands, bays and estuaries, riparian habitat, certain woods and grasslands, streams, lakes, and habitat for rare and endangered plants and animals. The Coastal Act defines "coastal zone" as an area, extending 3 miles (mi.) seaward and inland generally 1,000 yards (yd.) (914.4 meters [m]). In significant coastal estuarine, habitat, and recreational areas, it extends inland to a maximum of 5 mi. (8.1 kilometers [km]); in developed urban areas it generally extends inland less than 1,000 yd. (914.4 m).

As a component of the Proposed Action, the Navy initiated a Federal consistency process under the CZMA with the CCC. Previously, the Navy submitted a negative determination to the CCC for the NWTRC EIS. The proposed actions for the NWTT EIS and the NWTRC EIS are similar within the California coastal zone, the only difference being that the Study Area in the NWTT EIS starts at 12 nm from the coast, whereas in the NWTRC EIS Study Area a small portion of the Pacific Northwest OPAREA was located from 0 to 3 nm off of the Oregon Coast. Like the NWTT EIS, the Study Area was 12 nm off the California coast in the NWTRC EIS. Therefore, the Navy will again be submitting a negative determination, as the NWTT Study Area stops 12 nm short of the coastline and is well outside of the 3 nm coastal zone limit, and therefore activities in the Study Area will not affect the coastal zone.

6.1.1.4 Alaska Coastal Management Program

The Alaska Coastal Management Program (ACMP) ended at 12:01 a.m., Alaska Standard Time on 1 July 2011 per state legislative action (AS 44.66.030). The Legislature adjourned the special legislative session 14 May 2011 without passing legislation required to extend the ACMP. Therefore, Alaska currently does not have an approved CMP, and the Navy has no requirements to prepare and submit a consistency determination.

6.1.2 Marine Protected Areas

Many areas of the marine environment have some level of federal, state, or local management or protection. Marine protected areas (MPAs) have conservation or management purposes, defined boundaries, and some legal authority to protect resources. Marine protected areas vary widely in purpose, managing agency, management approaches, level of protection, and restrictions on human uses. They have been designated to achieve objectives ranging from conservation of biodiversity, to preservation of sunken historic vessels, to protection of spawning habitats important to commercial and recreational fisheries. Executive Order (EO) 13158*, Marine Protected Areas,* was created to "strengthen the management, protection, and conservation of existing marine protected areas and establish new or expanded marine protected areas; develop a scientifically based, comprehensive national system of

marine protected areas representing diverse U.S. marine ecosystems, and the nation's natural and cultural resources; and avoid causing harm to marine protected areas through federally conducted, approved, or funded activities."

Executive Order 13158 requires each Federal agency whose actions affect the natural or cultural resources that are protected by a national system of MPAs to identify such actions, and in taking such actions, avoid harm to those natural and cultural resources. Pursuant to Section 5 of EO 13158, agency requirements apply only to the natural or cultural resources specifically afforded protection by the site as described by the List of National System Marine Protected Areas. For sites that have both a terrestrial and marine area, only the marine portion and its associated protected resources are included on the List of National System Marine Protected Areas and subject to Section 5 of EO 13158. A full list and map of areas accepted in the National System of Marine Protected Areas is available from the National Marine Protected Areas Center.

The National Marine Protected Areas Center, which is federally managed through the NOAA, is tasked with implementing EO 13158. In order to meet the qualifications for the various terms within EO 13158, the National Marine Protected Areas Center developed a Marine Protected Areas Classification system. This system uses six criteria to describe the key features of most MPAs, as follows:

1) Primary conservation focus, such as natural heritage, cultural heritage, or sustainable production
2) Level of protection (e.g., no access, no impact, no take, zoned with no-take areas, zoned multiple use, or uniform multiple use)
3) Permanence of protection
4) Constancy of protection
5) Ecological scale of protection
6) Restrictions on extraction

The National Marine Protected Areas Center utilizes these criteria to evaluate MPAs for inclusion in the National System of MPAs. Implementation of the National System of MPAs is managed by the Department of Commerce (DOC) and the Department of the Interior (DOI). Executive Order 13158 requires the DOC and the DOI to consult with other federal agencies about the inclusion of sites into the National System of MPAs, including the Department of Defense (DoD). The National System of MPAs includes MPAs managed under the following six systems:

National Marine Sanctuary System. Under the National Marine Sanctuaries Act (NMSA), the NOAA establishes national marine sanctuaries for marine areas with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. Within the NWTT Study Area (Study Area) there is one National Marine Sanctuary System site, the Olympic Coast National Marine Sanctuary (OCNMS), which is included in the National System of Marine Protected Areas (Figure 6.1-1).

Marine National Monuments. Marine national monuments are designated through Presidential Proclamation under the authority of the Antiquities Act of 1906 (16 U.S.C. § 431). Marine national monuments are often co-managed by state, federal, and local governments, in order to preserve diverse habitats and ecosystem functions. There are no Marine National Monuments within the Study Area.

National Wildlife Refuge System. The U.S. Fish and Wildlife Service manages ocean and Great Lakes refuges for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats. There are nine National Wildlife Refuge areas near the Study Area: Bandon Marsh National Wildlife Refuge, Dungeness National Wildlife Refuge, Grays Harbor National Wildlife Refuge, Lewis and Clark National Wildlife Refuge, Nestucca Bay National Wildlife Refuge, Nisqually National Wildlife Refuge, Protection Island National Wildlife Refuge, Siletz Bay National Wildlife Refuge, and Willapa National Wildlife Refuge, all of which are included in the National System of MPAs (Table 6.1-2).

State and Local Marine Protected Areas. State and local governments have established MPAs for the management of fisheries, nursery grounds, shellfish beds, recreation, tourism, and other uses; these areas have a diverse array of conservation focuses, from protecting ecological functions, to preserving shipwrecks, to maintaining traditional or cultural interaction with the marine environment. In Washington there are seven state or local MPAs that are not included in the National System of Marine Protected Areas. In Oregon there is one state or local MPA that is not included in the National System of MPAs. California has four state or local MPAs that are not included in the National System of MPAs. There are three state or local eligible MPAs within the Western Behm Canal portion of the Study Area, but they are not included in the National System of Marine Protected Areas. In Washington, Oregon, and California combined, there are 26 state or local MPAs that are included in the National System of Marine Protected Areas (Table 6.1-2 and Figure 6.1-1).

National Parks System. The National Park System contains ocean and Great Lakes parks, including some national monuments, administered by the U.S. Department of the Interior National Park Service to conserve the scenery and the natural and historic objects and wildlife contained within. There is one National Parks System site, the Olympic National Park, within the Study Area. Because the Olympic National Park has a marine component—a band of area along the Washington Coast—it is included in the National System of Marine Protected Areas (Figure 6.1-1).

National Estuarine Research Reserve System. National Estuarine Research Reserve System sites protect estuarine land and water and provide essential habitat for wildlife, educational opportunities for student, teachers, and the public and living laboratories for scientists. There are no National Estuarine Research Reserve System sites within the Study Area.

This EIS/OEIS has been prepared in accordance with requirements for natural or cultural resources protected under the National System of MPAs. While several MPAs are located within the Study Area and are included in the National System of MPAs, it is important to note that through standard operating procedures, the Navy takes every precaution to train or test in these areas sparingly. Navy activities within these MPAs abide by the regulations of the individual MPA. Table 6.1-2 provides information on the individual MPA regulations and the Navy activities that occur in these areas. Additionally, the OCNMS within the Study Area receives protection under both EO 13158 and the NMSA, and is described in more detail below.

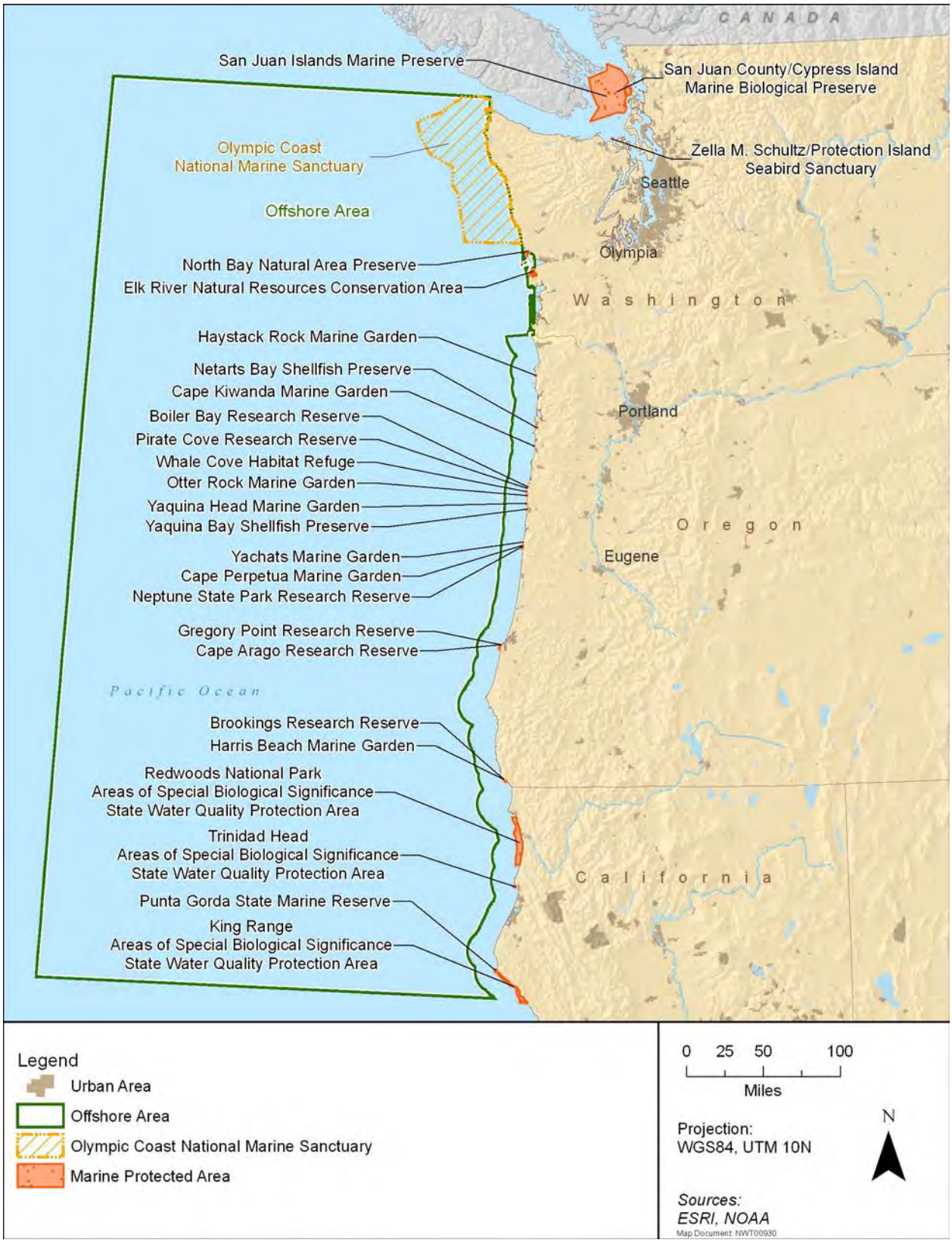

Figure 6.1-1: Map of Marine Protected Areas in the Study Area

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Admiralty Head Marine Preserve	Washington (Puget Sound)	Focal Resource	The recreational and commercial taking of fish, wildlife, and shellfish, except sea cucumbers and sea urchins, is prohibited.	The Navy's proposed activities in the Inland Waters portion of the Study Area, would not involve the taking of fish, wildlife, or shellfish for recreational or commercial use. The Navy's proposed activities would not occur in the Marine Preserve, and should not affect the Marine Protected Area resources in the Preserve.
Argyle Lagoon San Juan Islands Marine Preserve	Washington (Puget Sound)	Ecosystem	Prohibits commercial and recreational fishing for bottomfish and classified shellfish.	The Navy's proposed activities in the Inland Waters, which may affect some Preserve resources, but would not occur within the limits of the Preserve, would not involve the taking of fish, or shellfish.
Bandon Marsh National Wildlife Refuge	Oregon	Ecosystem	No applicable regulations to the Navy.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area.
Blake Island Underwater Park	Washington (Puget Sound)	Ecosystem	No applicable regulations to the Navy.	There are no applicable regulations to the Navy in this Park.
Brackett's Landing Shoreline Sanctuary Conservation	Washington (Puget Sound)	Ecosystem	Prohibits recreational and commercial fishing and the taking of all species of invertebrates and fishes.	The Navy's proposed activities in the Inland Waters, which may affect some Sanctuary resources, but would not occur within the limits of the Sanctuary, would not involve the taking of fish, wildlife, or shellfish.
Cherry Point Aquatic Reserve	Washington (Puget Sound)	Focal Resource	Prohibits the creation of new "hard" structured shoreline armoring on State-owned aquatic lands, underwater cable or pipeline structures, or new saltwater intakes.	The Navy's proposed activities in the Inland Waters, which may affect some Reserve resources, but would not occur within the limits of the Reserve, would not involve the creation of new "hard" structured shoreline.
Cypress Island Aquatic Reserve	Washington (Puget Sound)	Ecosystem	Prohibits mooring of boats more than 60 feet in length. Unless written permission is obtained from the Director of Friday Harbor Laboratories, the collection of any marine biological materials other than those taken for food, and also excepting kelp, is prohibited.	The Navy's proposed activities in the Inland Waters, which may affect some Reserve resources, but would not occur within the limits of the Reserve, would not involve boat mooring or the taking of biological materials.

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area (continued)

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Deception Pass Underwater Park	Washington (Puget Sound)	Ecosystem	No applicable regulations to the Navy.	The Navy's proposed activities in the Inland waters portion of the Study Area would not occur within the limits of the Park, nor would they affect the resources of the Park. There are no applicable regulations to the Navy in this Park.
Dungeness National Wildlife Refuge	Washington (Puget Sound)	Ecosystem	Prohibits access according with spatial boundaries and seasonal closures in the refuge.	The Navy's proposed activities in the Inland Waters, may affect some Refuge resources, but would not occur within the limits of the Refuge, and therefore would not violate the spatial boundaries or seasonal closures of the refuge.
False Bay San Juan Islands Marine Preserve	Washington (Puget Sound)	Ecosystem	Commercial and recreational fishing for bottomfish and classified shellfish is prohibited. Recreational and commercial fishing may occur for the harvesting of salmon, trout, and forage fishes except commercial fishing for Pacific herring.	The Navy's proposed activities in the Inland Waters, which may affect some Preserve resources, but would not occur within the limits of the Preserve, would not involve the taking of fish, or shellfish.
Fidalgo Bay Aquatic Reserve	Washington (Puget Sound)	Ecosystem	Uses that conflict with the purpose of the reserve designation and with its habitat and species identified for conservation are prohibited.	The Navy's proposed activities in the Inland Waters, which may affect some Reserve resources, but would not occur within the limits of the Reserve, would not involve uses that conflict with the purpose of the reserve.
Friday Harbor San Juan Islands Marine Preserve	Washington (Puget Sound)	Ecosystem	Commercial and recreational fishing for bottomfish and classified shellfish is prohibited. Recreational and commercial fishing may occur for the harvesting of salmon, trout, and forage fishes except commercial fishing for Pacific herring.	The Navy's proposed activities in the Inland Waters, which may affect some Preserve resources, but would not occur within the limits of the Preserve, would not involve the taking of fish, or shellfish.
Grays Harbor National Wildlife Refuge	Washington	Ecosystem	No applicable regulations to the Navy.	The Navy conducts no activities in or near this area.
Haro Strait Special Management Fishery Area	Washington (Puget Sound)	Focal Resource	Prohibits non-tribal commercial fishers from harvesting sea urchins and sea cucumbers.	The Navy's proposed activities in the Inland Waters, which may affect some Management Fishery Area resources, but would not occur within the limits of the Management Fishery Area, would not involve the taking of sea urchins or sea cucumbers.

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area (continued)

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
King Range ASBS State Water Quality Protection Area	California	Ecosystem	Prohibits discharge of elevated temperature wastes in a manner that would alter natural water quality conditions.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area. The Navy does not discharge wastes in or near this area.
Lewis and Clark National Wildlife Refuge	Oregon	Ecosystem	No applicable regulations to the Navy.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area.
Maury Island Aquatic Reserve	Washington (Puget Sound)	Focal Resource	Prohibits shellfish harvesting as a consequence of polluted waters and paralytic shellfish poisoning.	The Navy's proposed activities in the Inland Waters, which may affect some Reserve resources, but would not occur within the limits of the Reserve, would not involve the taking of shellfish.
Nestucca Bay National Wildlife Refuge	Oregon	Ecosystem	No applicable regulations to the Navy.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area.
Nisqually National Wildlife Refuge	Washington (Puget Sound)	Ecosystem	Prohibits consumptive uses at all times, and prohibits boating from 1 October to 31 March.	The Navy's proposed activities in the Inland Waters, which may affect some Refuge resources, but would not occur within the limits of the Refuge, would not involve consumptive uses, or boating from 1 October to 31 March.
Nisqually Reach Aquatic Reserve	Washington (Puget Sound)	Ecosystem	Shellfish harvest is prohibited in shellfish beds.	The Navy conducts no activities in this area, but does conduct infrequent testing activities in the Carr Inlet Operations Area, just north of McNeil Island (see Figure 2.1-7 in Chapter 2 of this EIS/OEIS). These testing activities would not affect shellfish beds.

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area (continued)

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Olympic Coast National Marine Sanctuary	Washington	Ecosystem	Prohibitions "…do not apply to military activities carried out by DoD as of the effective date (22 September 1980) of these regulations (15 C.F.R. § 922.73)." However, if any activities are "modified in such a way that requires the preparation of an environmental assessment or environmental impact statement...relevant to a Sanctuary resource or quality," said activity is not considered a pre-existing activity under these regulations. The regulations also state that "all DoD activities must be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources and qualities." If a DoD activity causes any destruction, loss, or injury to a Sanctuary resource then the "DoD, in coordination with the Director, must promptly prevent and mitigate further damage and must restore or replace the Sanctuary resource or quality in a manner approved by the Director." The Memorandum of Agreement Pursuant to the National Marine Sanctuaries Act 16 U.S.C. 1442 (e) between the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of National Marine Sanctuaries, and the U.S. Department of Homeland Security, United States Coast Guard Thirteenth Coast Guard District for the Purpose of Collaborative and Coordinated Management of the Olympic Coast National Marine Sanctuary (MOA-2013-020/8641), coordinates the efforts of the OCNMS and the U.S. Coast Guard to meet their common commitment to protecting and managing the Nation's coastal waters and marine resources within the OCNMS.	The Navy continues to conduct a number of activities in the Sanctuary, including live firing of guns, missiles, torpedoes, and chaff, and anti-submarine warfare activities. The activities under the Proposed Action were in effect before the establishment of the Sanctuary, and have not changed, nor have new activities been added such that formal consultation would be required. All DoD military activities shall be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on Sanctuary resources and qualities. No U.S. Coast Guard activities will occur in the OCNMS under the proposed action.

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area (continued)

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Olympic National Park	Washington	Ecosystem	It is prohibited for vessels to create a wake or exceed 5 miles per hour, 100 yards from shoreline in undeveloped areas. Permits are required for Aircraft and air delivery, delivery/retrieval of a person/object by parachute, helicopter or other airborne means, removal of a downed aircraft.	The Navy conducts no ship, submarine or land activities in Olympic National Park, but does conduct flight activities in the Olympic Military Operations Areas above the park.
Orchard Rocks Conservation Area	Washington (Puget Sound)	Focal Resource	The taking of all species of invertebrates and fishes by commercial or recreational fishing is prohibited.	The Navy conducts no activities in or near this area, but Navy ships may transit near or through the area.
Protection Island Aquatic Reserve	Washington (Puget Sound)	Ecosystem	Commercial trawling for finfish is prohibited.	The Navy conducts no activities in or near this area, but Navy ships may transit near or through the reserve.
Protection Island National Wildlife Refuge	Washington (Puget Sound)	Focal Resource	No regulations are applicable to the Navy.	There are no applicable regulations to the Navy in this Refuge.
Redwoods National Park ASBS State Water Quality Protection Area	California	Ecosystem	Prohibits discharge of elevated temperature wastes in a manner that would alter natural water conditions within the area.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area. The Navy does not discharge wastes in or near this area.
San Juan Channel and Upright Channel Special Management Fishery Area	Washington (Puget Sound)	Focal Resource	Regulations for the commercial non-Indian sea urchin and sea cucumber fisheries prohibit harvest of sea urchins and sea cucumbers within the closure areas. The closure areas are also identified within sea urchin and sea cucumber harvest management plans between the State and Treaty Tribes.	The Navy's proposed activities in the Inland Waters, which may affect some Management Fishery Area resources, but would not occur within the limits of the Management Fishery Area, would not involve the taking of sea urchins or sea cucumbers.
San Juan County/Cypress Island Marine Biological Preserve	Washington (Puget Sound)	Ecosystem	No person shall gather marine biological materials useful for scientific purposes, except when gathered as human food (or kelp); from the area of preserve except under permission first granted by the director of the Friday Harbor Laboratories of the University of Washington.	The Navy's proposed activities in the Inland Waters, which may affect some Preserve resources, but would not occur within the limits of the Preserve, would not involve the taking of biological materials.

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area (continued)

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Shaw Island San Juan Islands Marine Preserve	Washington (Puget Sound)	Ecosystem	Commercial and recreational fishing for bottomfish and most classified shellfish is prohibited.	The Navy's proposed activities in the Inland Waters, which may affect some Preserve resources, but would not occur within the limits of the Preserve, would not involve the taking of fish, or shellfish.
Siletz Bay National Wildlife Refuge	Oregon	Ecosystem	No regulations are applicable to the Navy.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area.
Smith and Minor Island Aquatic Reserve	Washington (Puget Sound)	Ecosystem	Prohibits commercial trawling of finfish. A 200-yard (183-meter) buffer surrounding Smith and Minor Islands prohibits boating activity in that zone.	The Navy's proposed activities in the Inland Waters, which may affect some Reserve resources, but would not occur within the limits of the Reserve, would not involve the taking of fish.
South Puget Sound Wildlife Area	Washington (Puget Sound)	Ecosystem	No regulations are applicable to the Navy.	The Navy conducts infrequent testing activities in the Carr Inlet Operations Area, just north of McNeil Island (see Figure 2.1-7 in Chapter 2 of this EIS/OEIS). There are no regulations applicable to the Navy in this Wildlife Area.
Sund Rock Conservation Area	Washington (Puget Sound)	Focal Resource	Prohibits commercial and recreational fishing, and taking of all species of invertebrates and fishes.	The Navy's proposed activities in the Inland Waters, which may affect some Conservation Area resources, but would not occur within the limits of the Conservation Area, would not involve the taking of fish, wildlife, or shellfish.
Trinidad Head ASBS State Water Quality Protection Area	California	Ecosystem	Prohibits discharge of elevated temperature wastes in a manner that would alter natural water conditions within the area.	The Navy conducts no activities in this area. The Navy does conduct ship transits and very limited training greater than 12 nm off the coast from this protection area. The Navy does not discharge wastes in or near this area.
Willapa National Wildlife Refuge	Washington	Ecosystem	No regulations are applicable to the Navy.	The Navy conducts no activities in or near this area, and there are no regulations applicable to the Navy in this Wildlife Refuge.
Yellow and Low Islands San Juan Islands Marine Preserve	Washington (Puget Sound)	Ecosystem	Commercial and recreational fishing for bottomfish and most classified shellfish is prohibited.	The Navy's proposed activities in the Inland Waters, which may affect some Preserve resources, but would not occur within the limits of the Preserve, would not involve the taking of fish, wildlife, or shellfish.

Table 6.1-2: Marine Protected Areas within the Northwest Training and Testing Study Area (continued)

Marine Protected Area	Location Within the Study Area	Protection Focus	Regulations Applicable to Navy Activities	Navy Proposed Activities and Potential Impacts
Zella M. Schultz/Protection Island Seabird Sanctuary	Washington (Puget Sound)	Focal Resource	Access by the public is prohibited.	The Navy's proposed activities in the Inland Waters, which may affect some Seabird Sanctuary resources, but would not occur within the limits of the Seabird Sanctuary, would not violate the Sanctuary's regulation that restricts access to the public.

Notes: ASBS = Area of Special Biological Significance, C.F.R. = Code of Federal Regulations, DoD = Department of Defense, EIS/OEIS = Environmental Impact Statement/Overseas Environmental Impact Statement, Navy = United States Department of the Navy, nm = nautical miles, OCNMS = Olympic Coast National Marine Sanctuary, U.S. = United States, U.S.C. = United States Code

6.1.2.1.1 Olympic Coast National Marine Sanctuary

The OCNMS consists of an area of 2,408 square nautical miles of marine waters and the submerged lands there off the Olympic Peninsula Coastline of Washington State (see Figure 6.1-1). The sanctuary extends 25–50 mi. (40.2–80.5 km) seaward, covering much of the continental shelf and several major submarine canyons. The boundaries of the sanctuary as defined in the OCNMS regulations (15 C.F.R. 922(O)) extend from Koitlah Point, due north to the United States/Canada international boundary, and seaward to the 100-fathom isobath (approximately 180 m in depth). The seaward boundary of the sanctuary follows the 100-fathom isobath south to a point due west of Copalis River, and cuts across the tops of Nitinat, Juan de Fuca, and the Quinault Canyons. The shoreward boundary of the sanctuary is at the mean lower low-water line when adjacent to American Indian lands and state lands, and includes the intertidal areas to the mean higher high-water line when adjacent to federally managed lands. When adjacent to rivers and streams, the sanctuary boundary cuts across the mouths but does not extend up river or up stream. The Memorandum of Agreement Pursuant to the National Marine Sanctuaries Act 16 U.S.C. 1442 (e) between the U.S. Department of Commerce, NOAA, National Ocean Service, Office of National Marine Sanctuaries, and the U.S. Department of Homeland Security, United States Coast Guard Thirteenth Coast Guard District for the Purpose of Collaborative and Coordinated Management of the Olympic Coast National Marine Sanctuary (MOA-2013-020/8641), coordinates the efforts of the OCNMS and the U.S. Coast Guard to meet their common commitment to protecting and managing the Nation's coastal waters and marine resources within the OCNMS. The offshore portion of the NWTT Study Area encompasses the OCNMS. All DoD military activities shall be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on Sanctuary resources and qualities. No U.S. Coast Guard activities will occur in the OCNMS under the proposed action.

Key habitats within the sanctuary include kelp forest, surfgrass, seafloor (sand and silt, gravel and cobbles), deep-sea coral and sponge gardens, rocky reefs, intertidal zone, nearshore subtidal, deepwater benthic, and water column habitat. The diversity of habitats, and the nutrient-rich upwelling zone (which exhibits the greatest volume of upwelling in North America) that drives high primary productivity in this province, contribute to the high species diversity in the OCNMS, with 309 species of fish, more than 56 species of seabirds and 24 species of shorebirds, occurring in the sanctuary (Office of National Marine Sanctuaries 2008). Twenty-nine species of marine mammals reside in or migrate through the OCNMS, including toothed and baleen whales, seals and sea lions, and sea otters (Office of National Marine Sanctuaries 2008).

Due to the Juan de Fuca Eddy ecosystem created from localized currents at the entrance to the Strait of Juan de Fuca, and the diversity of bottom habitats, the OCNMS supports a variety of invertebrates, including four of particular significance, the Pacific oyster, ocean pink shrimp, Dungeness crab, and razor clam. Decimation of razor clam populations, due to pathogen infestations and other natural calamities in the early 1980s, has ended commercial harvests; however, the Pacific oyster, ocean pink shrimp, and Dungeness crab are all large fisheries supported by the sanctuary's ecosystem. See Section 3.4 (Marine Mammals), Section 3.5 (Sea Turtles), Section 3.6 (Birds), Section 3.7 (Marine Vegetation), Section 3.8 (Marine Invertebrates), and Section 3.9 (Fish) for additional information on these species.

General Regulations for the OCNMS prohibit the following (15 C.F.R. § 922.152):

(a) Except as specified in paragraphs (b) through (g) of this section, the following activities are prohibited and thus are unlawful for any person to conduct or to cause to be conducted:

(1) Exploring for, developing or producing oil, gas or minerals within the Sanctuary.

(2) (i) Discharging or depositing, from within or into the Sanctuary, other than from a cruise ship, any material or other matter except:

(A) Fish, fish parts, chumming materials or bait used in or resulting from lawful fishing operations in the Sanctuary;

(B) Biodegradable effluent incidental to vessel use and generated by marine sanitation devices approved in accordance with section 312 of the Federal Water Pollution Control Act, as amended, (FWPCA), 33 U.S.C. 1322 *et seq.;*

(C) Water generated by routine vessel operations (e.g., cooling water, deck wash down, and graywater as defined by section 312 of the FWPCA) excluding oily wastes from bilge pumping;

(D) Engine exhaust; or

(E) Dredge spoil in connection with beach nourishment projects related to the Quillayute River Navigation Project.

(ii) Discharging or depositing, from beyond the boundary of the Sanctuary, any material or other matter, except those listed in paragraphs (a)(2)(i)(A) through (E) of this section, that subsequently enters the Sanctuary and injures a Sanctuary resource or quality.

(3) Discharging or depositing, from within or into the Sanctuary, any materials or other matter from a cruise ship except clean vessel engine cooling water, clean vessel generator cooling water, clean bilge water, engine exhaust, or anchor wash.

(4) Moving, removing or injuring, or attempting to move, remove or injure, a Sanctuary historical resource. This prohibition does not apply to moving, removing or injury resulting incidentally from lawful fishing operations.

(5) Drilling into, dredging or otherwise altering the submerged lands of the Sanctuary; or constructing, placing or abandoning any structure, material or other matter on the submerged lands of the Sanctuary, except as an incidental result of:

(i) Anchoring vessels;

(ii) Lawful fishing operations;

(iii) Installation of navigation aids;

(iv) Harbor maintenance in the areas necessarily associated with the Quillayute River Navigation Project, including dredging of entrance channels and repair, replacement or rehabilitation of breakwaters and jetties, and related beach nourishment;

(v) Construction, repair, replacement or rehabilitation of boat launches, docks or piers, and associated breakwaters and jetties; or

(vi) Beach nourishment projects related to harbor maintenance activities.

(6) Taking any marine mammal, sea turtle or seabird in or above the Sanctuary, except as authorized by the Marine Mammal Protection Act, as amended, (MMPA), 16 U.S.C. 1361 *et seq.,* the Endangered Species Act, as amended, (ESA), 16 U.S.C. 1531 *et seq.,* and the Migratory Bird Treaty Act, as amended, (MBTA), 16 U.S.C. 703 *et seq.,* or pursuant to any Indian treaty with an Indian tribe to which the United States is a party, provided that the Indian treaty right is exercised in accordance with the MMPA, ESA, and MBTA, to the extent that they apply.

(7) Flying motorized aircraft at less than 2,000 ft. (609.6 m) both above the Sanctuary within 1 nm of the Flattery Rocks, Quillayute Needles, or Copalis National Wildlife Refuge, or within one nm seaward from the coastal boundary of the Sanctuary, except for activities related to tribal timber operations conducted on reservation lands, or to transport persons or supplies to or from reservation lands as authorized by a governing body of an Indian tribe.

(8) Possessing within the Sanctuary (regardless of where taken, moved or removed from) any historical resource, or any marine mammal, sea turtle, or seabird taken in violation of the MMPA, ESA, or MBTA, to the extent that they apply.

(9) Interfering with, obstructing, delaying or preventing an investigation, search, seizure or disposition of seized property in connection with enforcement of the Act or any regulation or permit issued under the Act.

(b) The prohibitions in paragraph (a)(2) through (5), (7), and (8) of this section do not apply to activities necessary to respond to emergencies threatening life, property, or the environment.

(c) The prohibitions in paragraphs (a)(2) through (5), (7), and (8) of this section do not apply to activities necessary for valid law enforcement purposes.

(d) (1) All Department of Defense military activities shall be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on Sanctuary resources and qualities.

(i) Except as provided in paragraph (d)(2) of this section, the prohibitions in paragraphs (a)(2) through (8) of this section do not apply to the following military activities performed by the Department of Defense in W-237A, W-237B, and Military Operating Areas Olympic A and B in the Sanctuary:

(A) Hull integrity tests and other deep water tests;

(B) Live firing of guns, missiles, torpedoes, and chaff;

(C) Activities associated with the Quinault Range including the in-water testing of non-explosive torpedoes; and

(D) Anti-submarine warfare operations.

(ii) New activities may be exempted from the prohibitions in paragraphs (a)(2) through (8) of this section by the Director after consultation between the Director and the Department of Defense. If it is determined that an activity may be carried out such activity shall be carried out in a manner that avoids to the maximum extent practicable any adverse impact on Sanctuary resources and qualities. Civil engineering and other

civil works projects conducted by the U.S. Army Corps of Engineers are excluded from the scope of this paragraph (d).

(2) The Department of Defense is prohibited from conducting bombing activities within the Sanctuary.

(3) In the event of threatened or actual destruction of, loss of, or injury to a Sanctuary resource or quality resulting from an untoward incident, including but not limited to spills and groundings caused by the Department of Defense, the Department of Defense shall promptly coordinate with the Director for the purpose of taking appropriate actions to respond to and mitigate the harm and, if possible, restore or replace the Sanctuary resource or quality.

(e) The prohibitions in paragraphs (a)(2) through (8) of this section do not apply to any activity executed in accordance with the scope, purpose, terms and conditions of a National Marine Sanctuary permit issued pursuant to §§ 922.48 and 922.153 or a Special Use permit issued pursuant to section 310 of the Act.

(f) Members of a federally recognized Indian tribe may exercise aboriginal and treaty-secured rights, subject to the requirements of other applicable law, without regard to the requirements of this part. The Director may consult with the governing body of a tribe regarding ways the tribe may exercise such rights consistent with the purposes of the Sanctuary.

(g) The prohibitions in paragraphs (a)(2) through (8) of this section do not apply to any activity authorized by any lease, permit, license, or other authorization issued after July 22, 1994, and issued by any Federal, State or local authority of competent jurisdiction, provided that the applicant complies with § 922.49, the Director notifies the applicant and authorizing agency that he or she does not object to issuance of the authorization, and the applicant complies with any terms and conditions the Director deems necessary to protect Sanctuary resources and qualities. Amendments, renewals and extensions of authorizations in existence on the effective date of designation constitute authorizations issued after the effective date.

(h) Notwithstanding paragraphs (e) and (g) of this section, in no event may the Director issue a National Marine Sanctuary permit under §§ 922.48 and 922.153 or a Special Use permit under section 310 of the Act authorizing, or otherwise approve: The exploration for, development or production of oil, gas or minerals within the Sanctuary; the discharge of primary-treated sewage within the Sanctuary; the disposal of dredged material within the Sanctuary other than in connection with beach nourishment projects related to the Quillayute River Navigation Project; or bombing activities within the Sanctuary. Any purported authorizations issued by other authorities after July 22, 1994 for any of these activities within the Sanctuary shall be invalid.

According to the National Marine Sanctuary Program Regulations for the OCNMS (15 C.F.R. § 922.152), the prohibitions "…in paragraphs (a)(2) through (8) of this section do not apply to the following military activities performed by the Department of Defense in W-237A, W-237B, and Military Operating Areas Olympic A and B in the Sanctuary: (A) Hull integrity tests and other deep water tests; (B) Live firing of guns, missiles, torpedoes, and chaff; (C) Activities associated with the Quinault Range including the in-water testing of non-explosive torpedoes; and (D) Anti-submarine warfare operations." However, "New activities may be exempted from the prohibitions in paragraphs (a)(2) through (8) of this section by the Director after consultation between the Director and the Department of Defense. If it is determined that an activity may be carried out such activity shall be carried out in a manner that avoids to the maximum

extent practicable any adverse impact on Sanctuary resources and qualities." If a DoD activity causes any destruction, loss, or injury to a sanctuary resource, then they "shall promptly coordinate with the Director for the purpose of taking appropriate actions to respond to and mitigate the harm and, if possible, restore or replace the Sanctuary resource or quality."

In general, most Armed Forces activities are exempt from the OCNMS requirement to obtain an Olympic National Marine Sanctuary permit. However, bombing is explicitly prohibited in the OCNMS. In addition, the Navy is required to consult with the OCNMS pursuant to the National Marine Sanctuary Act section 304(d), for any new activity that adversely affects or injures a sanctuary resource. Nevertheless, all DoD military activities shall be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on Sanctuary resources and qualities. Therefore, proposed activities are consistent with those described in the sanctuary's designation document and in Section 6.4.5 (Department of Defense Activities) of the *Olympic Coast National Marine Sanctuary Final Management Plan and Environmental Assessment* (2011), authored and published by the NOAA, and would continue to be exempt from the prohibitions identified in the Sanctuary's regulations. NWTT activities within the Sanctuary would be conducted with an extensive set of mitigations measures (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring) and will avoid to the maximum extent practicable any adverse impacts on the Sanctuary resources and qualities.

To ensure compliance with the National Marine Sanctuary Program Regulations and the interagency consultation requirements of National Marine Sanctuaries Act section 304(d), the Navy considered all newly proposed training and testing activities to determine which activities may destroy, cause the loss of, or injure sanctuary resources, or result in adverse impacts on sanctuary resources or qualities. The Navy concluded that the newly proposed activities could fall into the following three categories:

1. The following Navy activities may take place without an OCNMS permit because they were specifically exempted:

    - Live firing of guns, missiles, torpedoes, and chaff (explosives detonated in-air, at the surface, or in the water)

    Explosives detonated in-air, at the surface, or in the water (includes gunnery rounds, torpedoes, and missiles) could impact marine mammals, sea turtles, birds, invertebrates, floating vegetation, or fish that may be present in the area. Impacts are expected to range from temporary behavioral reactions to injury, damage, or death. However, the Navy implements mitigation measures to reduce the potential for impacts from the use of explosives (see Section 5.3.1.2.2, Acoustic Stressors – Explosives and Impulse Sound, and Section 5.3.2.1.2, Explosives and Impulse Sound). For a more detailed discussion of potential impacts to these resources from the use of explosives detonated in-air, at the surface, or in the water, see the following sections:
    - Section 3.4.3.2.2 (Impacts from Explosives) for marine mammals
    - Section 3.5.3.1.8 (Impacts from Explosives) for sea turtles
    - Section 3.6.3.1.2 (Impacts from Explosives) for birds
    - Section 3.7.3.1.1 (Impacts from Underwater Explosives) for vegetation
    - Section 3.8.3.1.2 (Impacts from Underwater Explosives and Other Impulse Sources) for invertebrates
    - Section 3.9.3.1.3 (Impacts from Explosives and Other Impulse Sound Sources) for fish

- Live firing of guns, missiles, torpedoes, and chaff (non-explosive practice munitions)

Military expended materials resulting from exempted activities include items that could directly strike marine mammals, sea turtles, birds, invertebrates, floating vegetation, or fish that may be present in the area. However, the probability of military expended materials directly striking a marine resource is extremely low. In addition, the Navy implements mitigation measures to reduce the potential for direct strike from non-explosive practice munitions (see Section 5.3.1.2.3, Physical Disturbance and Strike, and Section 5.3.2.2.2, Non-Explosive Practice Munitions). In addition to biological resources, military expended materials can land on marine substrates. For a more detailed discussion of potential impacts to these resources from the use of non-explosive practice munitions fired in-air or at the surface, see the following sections:

  - Section 3.3.3.2.2 (Impacts from Military Expended Materials) for marine habitats
  - Section 3.4.3.6.6 (Impacts from Military Expended Materials) for marine mammals
  - Section 3.5.3.3.3 (Impacts from Military Expended Materials) for sea turtles
  - Section 3.6.3.2.3 (Impacts from Military Expended Materials) for birds
  - Section 3.7.3.2.2 (Impacts from Military Expended Materials) for vegetation
  - Section 3.8.3.3.2 (Impacts from Military Expended Materials) for invertebrates
  - Section 3.9.3.3.2 (Impacts from Military Expended Materials) for fish

- Anti-submarine warfare operations

Anti-submarine warfare activities commonly involve the use of sonar and other active acoustic sources. Sonar and other active acoustic sources are expected to cause only a minor and temporary behavioral reaction for invertebrates (cephalopods and crustaceans), diving birds, or fish that may be present in the area. No effect is anticipated to corals. Marine mammals and sea turtles could potentially be injured (permanent threshold shifts in hearing) from sonar and other active acoustic sources. However, although marine mammals and sea turtles may occur within the OCNMS, they should not be densely concentrated in this area; therefore, the likelihood of injury is low. Furthermore, the Navy implements mitigation measures to reduce the potential for marine mammals and sea turtles to be exposed to sonar and other active acoustic sources throughout the entire Study Area (see Section 5.3.1.2.1, Acoustic Stressors – Non-Impulse Sound, and Section 5.3.2.1.1, Non-Impulse Sound). For a more detailed discussion of potential impacts to these resources from the use of sonar and other active acoustic sources, see the following sections:

  - Section 3.4.3.2.1 (Impacts from Sonar and Other Active Acoustic Sources) for marine mammals
  - Section 3.5.3.1.7 (Impacts from Sonar and Other Active Acoustic Sources) for sea turtles
  - Section 3.6.3.1.1 (Impacts from Sonar and Other Active Acoustic Sources) for birds
  - Section 3.8.3.1.1 (Impacts from Sonar and Other Active Sources) for invertebrates
  - Section 3.9.3.1.2 (Impacts from Sonar and Other Active Acoustic Sources) for fish

2. The following Navy activities may take place within the OCNMS because they (1) are not likely to destroy, cause the loss of, or injure sanctuary resources or qualities, and (2) would not cause <u>significant impacts</u> on sanctuary resources:

- Activities involving aircraft and aerial targets

Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals, sea turtles, birds, or fish that may be present in

the area. However, in addition to behavioral reactions due to noise, seabirds could potentially be struck by aircraft or aerial targets. The Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

- Section 3.4.3.2.5 (Impacts from Aircraft Noise) for marine mammals
- Section 3.5.3.1.10 (Impacts from Vessel and Aircraft Noise) for sea turtles
- Section 3.6.3.1.3 (Impacts from Vessel Noise), Section 3.6.3.1.4 (Impacts from Aircraft Noise), and Section 3.6.3.2.1 (Impacts from Aircraft and Aerial Target Strikes) for birds
- Section 3.9.3.1.2 (Impacts from Sonar and Other Active Acoustic Sources) for fish

- Activities involving vessels and in-water devices (that do not make contact with seafloor)

Noise (other than sonar or radiated and induced noise) from vessels and in-water devices is expected to cause only a minor and temporary behavioral reaction for marine mammals, sea turtles, seabirds, or fish that may be present in the area. Marine mammals, sea turtles, seabirds, floating vegetation, and invertebrates could potentially be struck by or collide with vessels. However, the Navy implements mitigation measures to reduce the potential for vessel strikes of marine mammals (see Section 5.3.2.2, Physical Disturbance and Strike). In addition, all vessels use extreme caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance and can be stopped within a distance appropriate to the prevailing circumstances and conditions. For a more detailed discussion of potential impacts to these resources from the use of vessels and in-water devices, see the following sections:

- Section 3.4.3.4.1 (Impacts from Vessel Strike) and Section 3.4.3.4.2 (Impacts from In-Water Devices) for marine mammals
- Section 3.5.3.3.1 (Impacts from Vessels) and Section 3.5.3.3.2 (Impacts from In-Water Devices) for sea turtles
- Section 3.6.3.2.2 (Impacts from Vessels and In-Water Device Strikes) for birds
- Section 3.7.3.2.1 (Impacts from Vessels and In-Water Devices) for vegetation
- Section 3.8.3.3.1 (Impacts from Vessels and In-Water Devices) for invertebrates
- Section 3.9.3.3.1 (Impacts from Vessels and In-Water Devices) for fish

- Activities involving the use of electromagnetic devices

Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals, invertebrates (arthropods, such as lobsters), or fish that may be present in the area. For a more detailed discussion of potential impacts to these resources from the use of electromagnetic devices, see the following sections:

- Section 3.4.3.3.1 (Impacts from Electromagnetic Devices) for marine mammals
- Section 3.8.3.2.1 (Impacts from Electromagnetic Devices) for invertebrates
- Section 3.9.3.2.1 (Impacts from Electromagnetic Devices) for fish

3. Bombing activities would not take place within the OCNMS as part of the Proposed Action

6.2 Relationship Between Short-Term Use of the Environment and Maintenance and Enhancement of Long-Term Productivity

In accordance with the CEQ regulations (Part 1502), this EIS/OEIS analyzes of the relationship between the short-term impacts on the environment and the effects those impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This means that choosing one option may reduce future flexibility in pursuing other options, or that committing a resource to a certain use may often eliminate the possibility for other uses of that resource. The Navy, in partnership with NMFS, is committed to furthering the understanding of marine resources and developing ways to lessen or eliminate the impacts Navy training and testing activities may have on these resources. For example, the Navy and NMFS collaborate on the Integrated Comprehensive Monitoring Program for marine species to assess the impacts of training activities on marine species and investigate population-level trends in marine species distribution, abundance, and habitat use in various range complexes and geographic locations where Navy training and testing occurs. Another example, the Navy is a member of the OCNMS Advisory Council whose members are federal, state, local governments, non-governmental entities, and Native American Tribes and Nations. The sanctuary and members of the council share not only the boundary but concerns over species and habitat where the Navy trains and testing occurs.

The Proposed Action could result in both short- and long-term environmental impacts. However, these are not expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or general welfare of the public. The Navy is committed to sustainable military range management, including co-use of the Study Area with tribal, the general public, and commercial and recreational interests. This commitment to co-use of the Study Area will maintain long-term accessibility of the NWTT EIS/OEIS training and testing areas. Sustainable range management practices are specified in range complex management plans under the Navy's Tactical Training Theater Assessment and Planning Program. Among other benefits, these practices protect and conserve natural and cultural resources and preserve access to training areas for current and future training requirements while addressing potential encroachments that threaten to impact range and training area capabilities.

6.3 Irreversible or Irretrievable Commitment of Resources

The NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented" (42 U.S.C. § 4332). Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the uses of these resources have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (e.g., energy or minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., the disturbance of a cultural site).

For the Proposed Action, most resource commitments would be neither irreversible nor irretrievable. Most impacts would be short term and temporary, or long lasting but within historical or desired conditions. Because there would be no building or facility construction, the consumption of material typically associated with such construction (e.g., concrete, metal, sand, fuel) would not occur. Energy typically associated with construction activities would not be expended and irretrievably lost.

Implementation of the Proposed Action would require fuels used by aircraft and vessels, and would be the only irreversible and irretrievable resource commitment. Since fixed- and rotary-wing aircraft and ship activities could increase relative to the baseline, total fuel use would increase. Therefore, total fuel consumption would increase under the Proposed Action (Section 6.4), and this nonrenewable resource would be considered irretrievably lost (see Chapter 4, Cumulative Impacts, and the following discussion on the Navy's Climate Change Roadmap).

6.4 Energy Requirements and Conservation Potential of Alternatives and Mitigation Measures

The federal government consumes 2 percent of the total U.S. energy share (Jean 2010). Of that 2 percent, the DoD consumes 93 percent. The Navy consumes one-fourth of the total DoD share. The Navy consumes 1.2 billion to 1.6 billion gallons of fuel each year. The Navy expects an overall 25 percent increase in fuel consumption for the entire U.S. fleet, in the future because of new ships coming into the fleet and the growth in mission areas including, but not limited to, the NWTT Study Area (Jean 2010).

Increased training and testing activities within the Study Area would result in an increase in energy demand over the No Action Alternative. The increased energy demand would arise from an increase in fuel consumption, mainly from aircraft and vessels participating in training and testing. Details of fuel consumption by training and testing activities on an annual basis are set forth in the air quality emissions calculation spreadsheets available on the project website. Vessel and aircraft fuel consumption is estimated to increase by 0.5 and 0.5 million gallons per year under Alternative 1 and Alternative 2, respectively, when compared to the No Action Alternative. Conservative assumptions were made in developing the estimates, and therefore the actual amount of fuel consumed during training and testing events may be less than estimated. Nevertheless, the demand for fuel consumption would increase from baseline levels, given the proposed increases in training and testing activities.

Energy requirements would be subject to any established energy conservation practices. The use of energy sources has been minimized wherever possible without compromising safety, training, or testing activities. No additional conservation measures related to direct energy consumption by the proposed activities are identified.

The Navy is committed to improving energy security and environmental stewardship by reducing its reliance on fossil fuels. The Navy is actively developing and participating in energy, environmental, and climate change initiatives that will increase use of alternative energy and help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the Environmental Readiness Division is taking to implement EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. The Navy's Task Force Energy is responding to the Secretary of the Navy's Energy Goals through energy security initiatives that reduce the Navy's carbon footprint.

Two Navy programs—the Incentivized Energy Conservation (i-ENCON) Program and the Naval Sea Systems Command's (NAVSEA's) Fleet Readiness, Research and Development Program (FRR&DP)—are helping the fleet conserve fuel via improved operating procedures and long-term initiatives. The i-ENCON Program encourages the operation of ships in the most efficient manner while conducting their mission and supporting the Secretary of the Navy's efforts to reduce total energy consumption on naval ships. The NAVSEA's FRR&DP includes the High-Efficiency Heating, Ventilating, and Air Conditioning and the Hybrid Electric Drive for DDG-51 class ships, which are improvements to existing shipboard technologies that will both help with fleet readiness and decrease the ships' energy consumption and

greenhouse gas emissions. These initiatives are expected to greatly reduce the consumption of fossil fuels (see Section 3.2, Air Quality). Furthermore, to offset the impact of its expected near-term increased fuel demands and achieve its goals to reduce fossil fuel consumption and greenhouse gas emissions, the Navy plans to deploy, throughout the U.S. OPAREAs, by 2016 a green strike group (a "great green fleet") composed of nuclear vessels and ships powered by biofuel in local operations and with aircraft flying only with biofuels (Jean 2010).

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7 List of Preparers

TABLE OF CONTENTS

7 LIST OF PREPARERS 7-1

7.1 GOVERNMENT PREPARERS 7-1
7.2 CONTRACTOR PREPARERS 7-3

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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7 LIST OF PREPARERS

7.1 GOVERNMENT PREPARERS

Andrea Balla-Holden, Fisheries and Marine Mammal Biologist
Naval Facilities Engineering Command, Northwest
B.S., Fisheries, University of Washington
Years of Experience: 22

Jason M. Brustad, Bangor Waterfront Operations Manager
Naval Surface Warfare Center Carderock Division, Detachment Puget Sound
B.S., Business Administration and Management, Excelsior College
U.S. Navy Master Diver, Master Chief Petty Officer, USN (Ret.)
Years of Experience: 26

William Fagan, Trial Director, Facilities, and Mission Readiness Branch Head
Naval Surface Warfare Center, Carderock Division
B.S. Mechanical Engineer, University Of Idaho
Years of Experience: 29

Bill Harney, Site Director
Naval Surface Warfare Center, Carderock Division, Southeast Alaska Acoustic Measurement Facility
B.S. Electrical Engineering
Years of Experience: 40

George Hart, Biologist
Navy Region Northwest
M.S. Wildlife Science, University of Washington
Years of Experience: 27

Peter Hulton, Marine Mammal Acoustic Effects Modeling, Technical Project Manager
Naval Undersea Warfare Center, Division Newport
B.S., Mechanical Engineering, University of Rhode Island
Years of Experience: 31

Chip Johnson, Marine Species Advisor and Staff Marine Biologist
Commander, U.S. Pacific Fleet
M.A., Marine Science, Virginia Institute of Marine Science, College of William and Mary
B.S., Biology, University of North Carolina, Wilmington
Years of Experience: 16

Jennifer Kennelly, Senior Environmental Scientist
Navmar Applied Sciences Corporation
PMA-290 ESOH Contract Support
Years of Experience: 10

Kimberly Kler, Project Manager
Naval Facilities Engineering Command, Northwest
B.S., Environmental Policy Analysis and Planning, University of California, Davis
Years of Experience: 19

Joy Lapseritis, Biologist
Naval Undersea Warfare Center Division, Newport, Environmental Division,
Ph.D., Biological Oceanography, Massachusetts Institute of Technology & Woods Hole Oceanographic Institution
M.A., Biology and Marine Science, Smith College
B.A., Biology and Marine Science, Smith College
Years of Experience: 19

Susan Levitt, Environmental Engineer
Naval Sea Systems Command, Environmental Planning
B.S., Environmental Science, Allegheny College
Years of Experience: 24

John Mosher, Physical Scientist, Program Manager
Commander, U.S. Pacific Fleet
B.S., Geology, St. Lawrence University
Captain, USN Reserve
Years of Experience: 27

Corey Plakos, Environmental Scientist
Naval Air Systems Command Patuxent River, PMA-290 Environment, Safety, and Occupational Health Team Lead
M.S., Conservation and Marine Ecology, East Carolina University
Years of Navy Experience: 11

Gerald Sodano, Northwest Training Range Complex Sustainment Coordinator
Commander. U.S. Pacific Fleet
Air Traffic Control and Airspace Officer. Lieutenant Commander, USN (ret)
Years of Experience: 31

Roy Sokolowski, Environmental Protection Specialist – Acoustician
Commander, U.S. Pacific Fleet
Submarine Sonar Technician, Senior Chief Petty Officer, USN (ret)
Years of Experience: 28

Shaari Unger, Range Operations Environmental Coordinator
Naval Undersea Warfare Center Division, Keyport
System Acceptance & Operational Readiness Department
M.S. Eng., Underwater Acoustics, Pennsylvania State University
Years of Experience: 32

Ronni Wolfe, Range Support
Naval Undersea Warfare Center Division, Keyport
System Acceptance & Operational Readiness Department
Years of Experience: 11

7.2 CONTRACTOR PREPARERS

Elizabeth Becker (ManTech International Corporation), Senior Scientist
Ph.D., Marine Science, University of California Santa Barbara
Years of Experience: 25

Timberley Belish (Parsons), Project Scientist
M.S., Ecology and Evolution, University of Pittsburgh
B.S., Biology, Gannon University
Years of Experience: 19

Bruce Campbell (Parsons), Lead Analyst
M.S., Environmental Management, University of San Francisco
B.S., Environmental Biology, University of California, Santa Barbara
Years of Experience: 29

Joseph J. Campo (Parsons), Resource Section Author
Ph.D., Wildlife Ecology, Texas A&M University
M.S., Wildlife Ecology, Mississippi State University
B.S., Forestry, Louisiana State University
Years of Experience: 28

Mark A. Collins (Parsons), Environmental Scientist
B.S., Environmental Science, Ferrum College
Years of Experience: 22

Conrad Erkelens (ManTech SRS Technologies, Inc.), Senior Scientist
M.A., Anthropology, University of Hawaii
B.A., Anthropology, University of Hawaii
Years of Experience: 16

Jeremy Farr (Parsons), Environmental Planner
B.S., Environmental Management & Protection, California Polytechnic State University
Years of Experience: 3

Mark W. Kaminski (ManTech SRS Technologies, Inc), Military Operations Specialist
B.S., Education, Ohio University
Years of Experience: 21

Marya Kaminski (ManTech SRS Technologies, Inc.), Junior Marine Biologist
B.A., Environmental Studies: Biology/Ecology, Washington University in St. Louis
Years of Experience: 1

Robert Kull (Parsons), Analyst
M.S., Biology, University of North Carolina
B.A., Biology, University of the Pacific
Years of Experience: 31

Scott Lowry (Parsons), Editor
Ph.D., English, University of North Carolina
M.A., English, University of North Carolina
J.D., Ohio State University
B.S., Psychology, Ohio State University
Years of Experience: 23

Karyn Palma (ManTech SRS Technologies, Inc), Technical Editor
B.A., Environmental Studies, University of California, Santa Barbara
Years of Experience: 15

Cheryl Quaine (Parsons), Analyst
M.S., Environmental Science, Christopher Newport University
B.S., Zoology, University of Rhode Island
Years of Experience: 16

Carol-Ann Stewart (Parsons), Program Director
M.E.M., Masters in Engineering Management, George Washington University
B.S., Mechanical Engineering, University of Nevada, Reno
Years of Experience: 23

Heather Turner (ManTech SRS Technologies, Inc.), Marine Biologist
M.A.S., Marine Biodiversity and Conservation, Scripps Institution of Oceanography, University of California, San Diego
B.S., Environmental Science, University of California, Berkeley
Years of Experience: 4

Karen Waller (ManTech SRS Technologies, Inc.), Vice President/Quality Assurance
B.S., Public Affairs, Indiana University
Years of Experience: 22

Brian D. Wauer (ManTech SRS Technologies, Inc.), Project Manager
B.S., Administrative Management, University of Arkansas
B.S., Industrial Management, University of Arkansas
Years of Experience: 26

Seth Wilcher (Parsons), Cultural Resource Specialist
M.H.P., Historic Preservation, University of Georgia
B.S., History/Education, University of Georgia
Years of Experience: 9

Lawrence Wolski (ManTech SRS Technologies, Inc.), Marine Scientist
M.S., 1999, Marine Sciences, University of San Diego
B.S., 1994, Biology, Loyola Marymount University
Years of Experience: 14

Appendix A: Navy Activities Descriptions

TABLE OF CONTENTS

APPENDIX A NAVY ACTIVITIES DESCRIPTIONS A-1

A.1 TRAINING ACTIVITIES A-1
A.1.1 ANTI-AIR WARFARE TRAINING A-1
A.1.1.1 Air Combat Maneuver A-2
A.1.1.2 Missile Exercise (Air-to-Air) A-3
A.1.1.3 Gunnery Exercise (Surface-to-Air) A-4
A.1.1.4 Missile Exercise (Surface-to-Air) A-5
A.1.2 ANTI-SURFACE WARFARE TRAINING A-6
A.1.2.1 Gunnery Exercise Surface-to-Surface (Ship) A-7
A.1.2.2 Gunnery Exercise Surface-to-Surface (Boat) A-8
A.1.2.3 Missile Exercise Air-to-Surface A-9
A.1.2.4 Bombing Exercise Air-to-Surface A-10
A.1.2.5 Sinking Exercise A-11
A.1.3 ANTI-SUBMARINE WARFARE TRAINING A-13
A.1.3.1 Tracking Exercise – Submarine A-14
A.1.3.2 Tracking Exercise – Surface A-15
A.1.3.3 Tracking Exercise – Helicopter A-16
A.1.3.4 Tracking Exercise – Maritime Patrol Aircraft A-17
A.1.3.5 Tracking Exercise – Maritime Patrol Aircraft (Extended Echo Ranging Sonobuoys) A-18
A.1.4 ELECTRONIC WARFARE TRAINING A-19
A.1.4.1 Electronic Warfare Operations A-19
A.1.5 MINE WARFARE TRAINING A-20
A.1.5.1 Mine Neutralization – Explosive Ordnance Disposal A-20
A.1.5.2 Submarine Mine Exercise A-21
A.1.5.3 Maritime Homeland Defense/Security Mine Countermeasures Integrated Exercise A-22
A.1.6 NAVAL SPECIAL WARFARE TRAINING A-23
A.1.6.1 Personnel Insertion/Extraction – Submersible A-23
A.1.6.2 Personnel Insertion/Extraction – Non-Submersible A-24
A.1.7 OTHER TRAINING A-25
A.1.7.1 Precision Anchoring A-25
A.1.7.2 Small Boat Attack A-26
A.1.7.3 Intelligence, Surveillance, Reconnaissance A-27
A.1.7.4 Search and Rescue A-28
A.1.7.5 Surface Ship Sonar Maintenance A-29
A.1.7.6 Submarine Sonar Maintenance A-30
A.2 NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT TESTING ACTIVITIES A-31
A.2.1 TORPEDO TESTING A-32
A.2.1.1 Torpedo Non-Explosive Testing A-32
A.2.2 AUTONOMOUS AND NON-AUTONOMOUS VEHICLES A-33
A.2.2.1 Unmanned Underwater Vehicle Testing A-33
A.2.2.2 Unmanned Aircraft System A-34
A.2.2.3 Unmanned Surface Vehicle Testing A-35
A.2.3 FLEET TRAINING/SUPPORT A-36
A.2.3.1 Cold Water Training A-36

A.2.3.2 Post-Refit Sea Trial A-37
A.2.3.3 Anti-Submarine Warfare Testing A-38
A.2.4 MAINTENANCE AND MISCELLANEOUS A-39
A.2.4.1 Side Scan/Multibeam A-39
A.2.4.2 Non-Acoustic Tests A-40
A.2.5 ACOUSTIC COMPONENT TEST A-41
A.2.5.1 Countermeasures Testing A-41
A.2.5.2 Acoustic Test Facility A-42
A.2.5.3 Pierside Integrated Swimmer Defense A-43
A.3 NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION DETACHMENT PUGET SOUND TESTING ACTIVITIES A-44
A.3.1 SYSTEM, SUBSYSTEM AND COMPONENT TESTING A-45
A.3.1.1 Pierside Acoustic Testing A-45
A.3.1.2 Performance Testing at Sea A-46
A.3.1.3 Development Training and Testing A-47
A.3.2 PROOF OF CONCEPT TESTING A-48
A.3.2.1 Proof-of-Concept Testing A-48
A.4 NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION, SOUTHEAST ALASKA ACOUSTIC MEASUREMENT FACILITY TESTING ACTIVITIES A-49
A.4.1 NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION, SOUTHEAST ALASKA ACOUSTIC FACILITY A-49
A.4.1.1 Surface Vessel Acoustic Measurement A-49
A.4.1.2 Underwater Vessel Acoustic Measurement A-50
A.4.1.3 Underwater Vessel Hydrodynamic Performance Measurement A-51
A.4.1.4 Cold Water Training A-52
A.4.1.5 Component System Testing A-53
A.4.1.6 Countermeasures Testing A-54
A.4.1.7 Electromagnetic Measurement A-55
A.4.1.8 Measurement System Repair and Replacement A-56
A.4.1.9 Project Operations A-57
A.4.1.10 Target Strength Trial A-58
A.5 NAVAL SEA SYSTEMS COMMAND PROGRAM OFFICE SPONSORED TESTING ACTIVITIES A-59
A.5.1 LIFE CYCLE ACTIVITIES A-59
A.5.1.1 Pierside Sonar Testing A-59
A.5.2 SHIPBOARD PROTECTION SYSTEMS AND SWIMMER DEFENSE TESTING A-60
A.5.2.1 Pierside Integrated Swimmer Defense A-60
A.5.3 UNMANNED VEHICLE TESTING A-61
A.5.3.1 Unmanned Vehicle Development and Payload Testing A-61
A.5.4 ANTI-SURFACE WARFARE/ANTI-SUBMARINE WARFARE TESTING A-62
A.5.4.1 Torpedo (Explosive) Testing A-62
A.5.4.2 Torpedo (Non-Explosive) Testing A-63
A.5.4.3 Countermeasure Testing A-64
A.5.5 NEW SHIP CONSTRUCTION A-65
A.5.5.1 Anti-Submarine Warfare Mission Package Testing A-65
A.6 NAVAL AIR SYSTEMS COMMAND TESTING ACTIVITIES A-66
A.6.1 ANTI-SUBMARINE WARFARE A-67
A.6.1.1 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Directional Command Activated Sonobuoy System A-67
A.6.1.2 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Multistatic Active Coherent

Sonobuoy System A-68
A.6.1.3 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Signal, Underwater Sound Sonobuoys A-69
A.6.1.4 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Improved Extended Echo Ranging Sonobuoy System A-70
A.6.1.5 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – High Duty Cycle Sonobuoy System A-71
A.6.2 ELECTRONIC WARFARE A-72
A.6.2.1 Flare Test A-72

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

There are no figures in this section.

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APPENDIX A NAVY ACTIVITIES DESCRIPTIONS

The United States (U.S.) Department of the Navy's (Navy's) activities can generally be categorized as either training or testing. Training activities involve Navy service members employing tactics and established weapons systems in a realistic manner to prepare for combat or similar situations. Testing activities, which include research, development, test, and evaluation (RDT&E), are performed to ensure that U.S. military forces have the latest technologies with which to engage in hostile or hazardous situations.

The descriptions that follow are intended to provide a better understanding of each training and testing activity commonly conducted by naval forces.

The Navy's training activities are organized generally into eight primary mission areas and a miscellaneous category (other training) that includes those activities that don't fall within one of the eight primary mission areas, but are an essential part of Navy training. Many of the activities described here may have a land component, occurring both at sea and on or over land. In this Environmental Impact Statement (EIS)/Overseas EIS (OEIS), only the at-sea component is analyzed, except for activities occurring in the Olympic Military Operations Area (MOA) which have a shoreline component.

A.1 TRAINING ACTIVITIES

The Navy's training activities are organized generally into eight primary mission areas (two of which are not conducted in the Northwest; Amphibious Warfare and Strike Warfare) and a miscellaneous category (Other Training) that includes those activities that do not fall within a primary mission area, but are an essential part of Navy training.

A.1.1 ANTI-AIR WARFARE TRAINING

Anti-air warfare is the primary mission area that addresses combat operations by air and surface forces against hostile aircraft. Navy ships contain an array of modern anti-aircraft weapon systems, including naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar controlled cannons for close-in point defense. Strike/fighter aircraft carry anti-aircraft weapons, including air-to-air missiles and aircraft cannons. Anti-air warfare training encompasses events and exercises to train ship and aircraft crews in employment of these weapons systems against simulated threat aircraft or targets. Anti-air warfare training includes surface-to-air gunnery, surface-to-air and air-to-air missile exercises, and aircraft force-on-force combat maneuvers.

A.1.1.1 Air Combat Maneuver

Activity Name	Activity Description	
Anti-Air Warfare		
Air Combat Maneuver	**Short Description:** Aircrews engage in flight maneuvers designed to gain a tactical advantage during combat.	
Long Description	Basic flight maneuvers where aircrew engage in offensive and defensive maneuvering against each other. During an air combat maneuver engagement, no ordnance is fired, countermeasures such as chaff and flares may be used. These maneuvers typically involve two aircraft; however, based upon the training requirement, air combat maneuver exercises may involve over a dozen aircraft. Participants typically are two or more aircraft. No weapons are fired.	
Information Typical to the Event	**Platform:** Fixed-wing aircraft (e.g., EA-6B, EA-18G) **Systems:** None **Ordnance/Munitions:** None **Targets:** None **Duration:** 1–2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Aircraft noise **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Chaff and flares	
Assumptions Used for Analysis	No munitions fired. Flare and chaff may be used. All flare and chaff analyzed under flare exercise and chaff exercise events.	

A.1.1.2 Missile Exercise (Air-to-Air)

Activity Name	Activity Description	
Anti-Air Warfare		
Missile Exercise (Air-to-Air)	**Short Description:** Aircrews defend against threat aircraft with missiles.	
Long Description	An event involves two or more jet aircraft and a target. Missiles are non-explosive practice munitions or high explosive warheads. The target is an unmanned aerial target drone (e.g., BQM-34, BQM-74), a Tactical Air-Launched Decoy, or a parachute suspended illumination flare. Target drones deploy parachutes and are recovered by boat or helicopter; Tactical Air-Launched Decoys and illumination flares are expended and not recovered. These events typically occur at high altitudes. Anti-air missiles may also be employed when training against threat missiles.	
Information Typical to the Event	**Platform:** Fixed wing aircraft (e.g., FA-18C, EA-18G, F-35) **Systems:** None **Ordnance/Munitions:** Anti-air missiles (e.g., AIM-7, AIM-9, AIM-120 [non-explosive and high explosive]) **Targets:** BQM-34, BQM-74, Tactical Air-Launched Decoy, illumination flare (e.g., LUU-2) **Duration:** 1–2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike (target and missile fragment) **Entanglement:** Decelerator/parachutes **Ingestion:** Military expended materials (missile fragments, decelerator/parachute, flare casing, target fragments)	
Detailed Military Expended Materials Information	Decelerator/parachutes, flare casings, missile body, target fragments, missile fragments	
Assumptions Used for Analysis	1.25 missiles per event. Half of all missiles have explosive warheads, half are non-explosive. Assume 1.5 flares per Missile Exercise event	

A.1.1.3 Gunnery Exercise (Surface-to-Air)

Activity Name	Activity Description	
Anti-Air Warfare		
Gunnery Exercise (Surface-to-Air)	**Short Description:** Surface vessel crews defend against threat aircraft or missiles with large/medium-caliber guns.	
Long Description	Surface vessel personnel defend against threat aircraft or missile targets with guns to disable or destroy the threat. An event involves one vessel and a simulated threat aircraft or anti-vessel missile that is detected by the vessel's radar. Medium-caliber guns fire projectiles, typically non-explosive, to disable or destroy the threat before it reaches the vessel. The target is towed by a commercial air services jet.	
Information Typical to the Event	**Platform:** Surface vessel (all) **Systems:** None **Ordnance/Munitions:** Large/medium-caliber munitions (non-explosive) **Targets:** Towed banners behind aircraft **Duration:** 1–2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Aircraft noise, vessel noise, weapons firing noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike (projectiles), vessel strike, aircraft strike (seabirds only) **Entanglement:** None **Ingestion:** Projectiles, casings	
Detailed Military Expended Materials Information	Projectiles Casings	
Assumptions Used for Analysis	All projectiles are non-explosive. Close In Weapon System employed in all events. Routine Close In Weapon System maintenance related firing can occur throughout study area, as long as a clear range is established. This is conducted at altitudes as low as 3,000 feet.	

A.1.1.4 Missile Exercise (Surface-to-Air)

Activity Name	Activity Description	
Anti-Air Warfare		
Missile Exercise (Surface-to-Air)	**Short Description:** Surface vessel crews engage threat missiles and aircraft with missiles.	
Long Description	Surface vessel crews defend against threat missiles and aircraft with vessel launched missiles. The event involves a simulated threat aircraft or anti-ship missile which is detected by the vessel's radar. Vessel launched anti-air missiles are fired (high explosive) to disable or destroy the threat. The target typically is a remote controlled drone. Anti-air missiles may also be used to train against land attack missiles.	
Information Typical to the Event	**Platform:** Surface vessels (all) **Systems:** None **Ordnance/Munitions:** Anti-air missiles (e.g., Sea Sparrow, Standard Missile SM-2, Rolling Airframe Missile [high explosive]) **Targets:** Unmanned drones (e.g., BQM-34, BQM-74) **Duration:** 1–2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike (missile fragments), vessel strike, aircraft strike (seabirds only) **Entanglement:** None **Ingestion:** Missile fragments	
Detailed Military Expended Materials Information	Missile fragments	
Assumptions Used for Analysis	Two missiles per event. All anti-air missiles are high explosive. Missile explodes well above the ocean surface. All explosive and propellant consumed. Target typically not destroyed, unmanned drones are recovered.	

A.1.2 ANTI-SURFACE WARFARE TRAINING

Anti-surface warfare is a type of naval warfare in which aircraft, surface ships, and submarines employ weapons and sensors in operations directed against enemy surface ships or boats. Air-to-surface exercises are conducted by long-range attacks using simulated air-launched cruise missiles or other precision guided munitions, bombs, or aircraft cannon. Anti-surface warfare is also conducted by warships employing torpedoes, naval guns, and surface-to-surface missiles. In the Northwest Training and Testing (NWTT) Study Area, warships will use only naval guns during exercises; use of torpedoes and missiles by surface ships will be simulated within the Study Area. Submarines will also simulate attacks on surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. Gunnery training generally involves expenditure of ordnance (normally non-explosive practice munitions) against a towed or floating target. A sinking exercise is a specialized training event that provides an opportunity for ship, submarine, and aircraft crews to use multiple weapons systems to deliver high explosive ordnance on a deactivated vessel, which is deliberately sunk. Sinking exercises are no longer conducted in the NWTT Study Area. Anti-surface warfare also encompasses maritime security, that is, the interception of a suspect surface ship by a Navy ship for the purpose of boarding-party inspection or the seizure of the suspect ship. Training in these tasks is conducted in visit, board, search and seizure exercises.

A.1.2.1 Gunnery Exercise Surface-to-Surface (Ship)

Activity Name	Activity Description	
Anti-Surface Warfare		
Gunnery Exercise Surface-to-Surface (Ship)	**Short Description:** Vessel crews engage surface targets with vessel's small-, medium-, and large-caliber guns designed to provide close range defense against patrol boats, smaller boats, swimmers, and floating mines. Some of the small- and medium-caliber gunnery exercises analyzed include those conducted by the U.S. Coast Guard.	
Long Description	This exercise involves vessel crews engaging surface targets at sea with small-, medium-, and large-caliber weapons. Vessels use small caliber weapons to practice defensive marksmanship, typically against stationary floating targets. The target may be a 10-foot diameter red balloon (Killer Tomato), a 50-gallon steel drum, or other available target, such as a cardboard box. Some targets are expended during the exercise and are not recovered. Vessel crew qualifications conducted at sea employ stationary targets on deck. Small-, medium-, and large-caliber projectiles fired during these events will be expended in the water. Shipboard protection systems utilizing small caliber projectiles will train against high speed mobile targets. Some of the small- and medium-caliber gunnery exercises analyzed include those conducted by the U.S. Coast Guard.	
Information Typical to the Event	**Platform:** Surface vessels **Systems:** None **Ordnance/Munitions:** Small-, medium-, and large-caliber (non-explosive) **Targets:** Recoverable or expendable floating target (stationary or towed), remote controlled high speed targets **Duration:** 2–3 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Vessel noise, weapons firing noise, underwater explosions (e.g., E1, E5) **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strike, military expended materials strike (projectile), target strike **Entanglement:** None **Ingestion:** Small-caliber projectiles, casings, target fragments	
Detailed Military Expended Materials Information	Small-, medium-, and large-caliber projectiles Casings Target fragments	
Assumptions Used for Analysis	Small-caliber rounds: 121,200 non-explosive practice munitions annually Medium-caliber rounds: 33,492 non-explosive practice munitions, and 178 high explosive (HE) munitions annually Large-caliber rounds: 2,720 non-explosive practice munitions and 160 HE munitions annually.	

A.1.2.2 Gunnery Exercise Surface-to-Surface (Boat)

Activity Name	Activity Description	
Anti-Surface Warfare		
Gunnery Exercise Surface-to-Surface (Boat)	**Short Description:** Small boat crews engage surface targets with small-caliber (blank) weapons.	
Long Description	Boat crews engage surface targets with small-caliber (blank) weapons. Boat crews may use high or low speeds to approach and engage targets simulating other boats, swimmers, floating mines, or near shore land targets with small-caliber (blank) weapons. A number of different types of boats are used depending on the unit using the boat and their mission. Boats are most used to protect ships in harbors and high value units, such as: aircraft carriers, nuclear submarines, liquid natural gas tankers, etc., while entering and leaving ports. Boats are also used to conduct riverine operations and various naval special warfare operations. The boats used by these units include: small unit river craft, combat rubber raiding craft, rigid-hull inflatable boats, patrol craft, and many other versions of these types of boats. These boats use inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion.	
Information Typical to the Event	**Platform:** Boats **Systems:** None **Ordnance/Munitions:** Small-caliber (non-explosive, blank) **Targets:** Recoverable or expendable floating target **Duration:** 1 hour	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Vessel noise, weapons firing noise **Energy:** None **Physical Disturbance and Strike:** Vessel strike, in-water device strike, military expended material strike (casings) **Entanglement:** None **Ingestion:** Casings	
Detailed Military Expended Materials Information	Casings	
Assumptions Used for Analysis	1,500 small-caliber rounds fired annually, all blanks. No rounds, but some shell casings could be expended.	

A.1.2.3 Missile Exercise Air-to-Surface

Activity Name	Activity Description	
Anti-Surface Warfare		
Missile Exercise (Air-to-Surface)	**Short Description:** Fixed-wing aircrews simulate firing precision-guided missiles, using captive air training missiles (CATMs) against surface targets. Some activities include firing a missile with a high explosive (HE) warhead.	
Long Description	Fighter and maritime patrol aircraft simulate the firing of precision-guided missiles against surface targets. The aircrew uses sensors, usually radar, to locate a surface target. The crew then simulates the firing of an actual missile by using a non-firing CATM that has been loaded on the aircraft. Some activities include firing a missile with a HE warhead at a target.	
Information Typical to the Event	**Platform:** Fixed wing aircraft (e.g., EA-6B, EA-18G) **Systems:** None **Ordnance/Munitions:** Air-to-surface missile (HE) **Targets:** Recoverable floating target (stationary or towed), Remotely operated target **Duration:** 2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Aircraft noise, tow vessel noise, underwater explosions (e.g., E10) **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike (missile), vessel strike, aircraft strike (seabirds only) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Missile fragments	
Assumptions Used for Analysis	Assume one target per event. Most missiles are non-firing. Some missiles are live missiles with HE warhead (4 HE missiles per year).	

A.1.2.4 Bombing Exercise Air-to-Surface

Activity Name	Activity Description	
Anti-Surface Warfare		
Bombing Exercise (Air-to-Surface)	**Short Description:** Fixed-wing aircrews deliver bombs against surface targets.	
Long Description	Fixed-wing aircrews deliver bombs against surface targets. Aircraft altitudes during delivery can be as low as 400 feet. Fixed-wing aircraft conduct a bombing exercise against stationary floating targets (e.g.: MK-58 smoke buoy). An aircraft clears the area, deploys a smoke buoy or other floating target, and then delivers high explosive (HE) or non-explosive practice munitions (NEPM) bomb(s) on the target. A range boat may be used to deploy targets for an aircraft to attack. The majority of bombing exercises conducted within the Northwest Training and Testing Study Area utilize NEPM. Exercises for strike fighters typically involve a flight of two aircraft delivering unguided or guided munitions that may be either HE or NEPM. The following munitions may be employed by strike fighter aircraft in the course of the bombing exercise: Unguided munitions: Non explosive sub-scale NEPM bombs (MK-76 and Bomb Dummy Unit [BDU]-45), explosive and non-explosive general purpose bombs (MK-80 series). Precision-guided munitions: Laser-guided bombs (explosive, non-explosive), Laser-guided Training Rounds (non-explosive), Joint Direct Attack Munition (explosive, non-explosive).	
Information Typical to the Event	**Platform:** Fixed wing (e.g., F/A-18, F-35, P-8, P-3) **Systems:** None **Ordnance/Munitions:** Bombs (e.g., MK-76, BDU-45, MK-80 series **Targets:** Expendable floating target (e.g., smoke float) **Duration:** 1 hour	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Underwater explosions (e.g., E12), aircraft noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike (non-explosive bomb), aircraft strike (seabirds only) **Entanglement:** None **Ingestion:** Bomb fragments, Target fragments, Smoke floats	
Detailed Military Expended Materials Information	Bomb fragments Inert Bombs Target fragments Smoke floats	
Assumptions Used for Analysis	Approximately 90 percent of non-explosive bombs are the sub-scale NEPM bombs such as the MK-76 and BDU-48. 110 NEPM and 10 HE bombs annually.	

A.1.2.5 Sinking Exercise

Activity Name	Activity Description	
Anti-Surface Warfare		
Sinking Exercise	**Short Description:** Aircraft, vessel, and submarine crews deliver ordnance on a seaborne target, usually a deactivated ship, which is deliberately sunk using multiple weapon systems. Sinking exercises are included in the No Action Alternative for the purpose of analysis, but are not part of the Proposed Action.	
Long Description	Ship personnel and aircrew deliver high explosive ordnance on a seaborne target, (large deactivated vessel), which is deliberately sunk using multiple weapon systems. A sinking exercise is typically conducted by aircraft, surface vessels, and submarines in order to take advantage of the ability to fire high-explosive ordnance on a full-size ship target. The target is typically a decommissioned ship made environmentally safe for sinking according to U.S. Environmental Protection Agency standards. The location is greater than 50 nautical miles (nm) from shore and in water depths greater than 6,000 feet (ft.). Vessel, aircraft, and submarine crews attack with coordinated tactics and deliver live high explosive ordnance to sink the target. Non-explosive practice munitions may be used during the initial stages to extend target life. Typically, the exercise lasts for 4–8 hours and possibly over 1–2 days; however it is unpredictable, and ultimately ends when the ship sinks.	
Information Typical to the Event	**Platform:** Vessels, Aircraft, Submarines **Systems:** None **Ordnance/Munitions:** Potentially all available (explosive and non-explosive) **Targets:** Decommissioned ship made environmentally safe for sinking (according to U.S. Environmental Protection Agency standards) **Duration:** 4–8 hours, possibly over 1–2 days (unpredictable and ultimately ends when the ship sinks)	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Underwater explosions (e.g., E5, E8, E11, E12), vessel noise, aircraft noise, weapons firing noise, heavyweight torpedo (e.g., TORP2) **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike (non-explosive projectiles, projectile fragments), vessel strike, aircraft strike (seabirds only) **Entanglement:** Guidance wires **Ingestion:** Munitions fragments, small caliber projectiles, casings	
Detailed Military Expended Materials Information	Munitions fragments, Non-explosive ordnance, Guidance wires, Munitions fragments, Casings Ship hulk (decommissioned ship made environmentally safe for sinking according to U.S. Environmental Protection Agency standards)	

Activity Name	Activity Description
Anti-Surface Warfare	
Assumptions Used for Analysis	Greater than 50 nm from shore and in water depths greater than 6,000 ft. The participants and assets could include: • One full-size target ship hulk • One to five cruiser, destroyer, or frigate ships • One to 10 F/A-18, or maritime patrol aircraft • One or two HH-60H, MH-60R/S, or SH-60B helicopters • One E-2 aircraft for Command and Control • One submarine • One to three range clearance aircraft • Two to four Harpoon surface-to-surface or air-to-surface missiles • Two to eight air-to-surface Maverick missiles • Two to 16 MK-82 general purpose bombs • Two to four Hellfire air-to-surface missiles • One or two SLAM-ER air-to-surface missiles • Fifty to 500 rounds 5-inch and 76-millimeter (mm) gun • One to two MK-48 heavyweight submarine-launched torpedo • Two to 10,000 rounds .50 caliber and 7.62 mm • Assume two guidance wires expended per event

A.1.3 ANTI-SUBMARINE WARFARE TRAINING

Anti-submarine warfare involves helicopter and maritime patrol aircraft, ships, and submarines. These units operate alone or in combination, in operations to locate, track, and neutralize submarines. Controlling the undersea battle space is a unique naval capability and a vital aspect of sea control. Undersea battle space dominance requires proficiency in anti-submarine warfare. Every deploying strike group and individual surface combatant must possess this capability.

Various types of active and passive sonar are used by the Navy to determine water depth, locate mines, and identify, track, and target submarines. Passive sonar "listens" for sound waves by using underwater microphones, called hydrophones, which receive, amplify, and process underwater sounds. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character, and movement of submarines; however, passive sonar, as a tool for detecting submarines, is increasingly ineffective as modern submarines become quieter. Active sonar is needed to locate objects because active sonar provides both bearing and range to the detected contact (such as an enemy submarine).

Active sonar transmits pulses of sound that travel through the water, reflect off objects and return to a receiver. By knowing the speed of sound in water and the time taken for the sound wave to travel to the object and back, active sonar systems can quickly calculate direction and distance from the sonar platform to the underwater object.

The Navy's anti-submarine warfare training plan, including the use of active sonar in at-sea training scenarios, includes multiple levels of training. Individual-level anti-submarine warfare training addresses basic skills such as detection and classification of contacts, distinguishing discrete acoustic signatures including those of ships, submarines, and marine life, and identifying the characteristics, functions, and effects of controlled jamming and evasion devices.

More advanced, integrated anti-submarine warfare training exercises involving active sonar are conducted in coordinated, at-sea operations during multi-dimensional training events involving submarines, ships, aircraft, and helicopters. This training integrates the full anti-submarine warfare continuum from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons. Training events include detection and tracking exercises against "enemy" submarine contacts; torpedo employment exercises against the target; and exercising command and control tasks in a multi-dimensional battle space.

A.1.3.1 Tracking Exercise – Submarine

Activity Name	Activity Description	
Anti-Submarine Warfare		
Tracking Exercise – Submarine	**Short Description:** Submarine crews search for, track, and detect submarines.	
Long Description	The anti-submarine warfare tracking exercise-submarine involves a submarine employing hull mounted and/or towed array sonar against an anti-submarine warfare target such as a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30, or another submarine. During this event, passive sonar is used almost exclusively; active sonar use is restricted because it would reveal the tracking submarine's presence to the target submarine. The preferred type of range for this exercise is an instrumented underwater training range with the capability to track the locations of submarines and targets, to enhance the after-action learning component of the training. This exercise may involve a single submarine, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event.	
Information Typical to the Event	**Platform:** Submarines **Systems:** Mid-frequency (primarily passive) and high-frequency sonar **Ordnance/Munitions:** None **Targets:** Submarine MK-30, MK-39 Expendable Mobile Anti-Submarine Warfare Training Target **Duration:** 8 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Submarine high-frequency navigation and mine hunting sonar (e.g., HF1), Portable Underwater Tracking Range (e.g., HF6 and P2), submarine sonar (BQQ-10) (e.g., MF3) **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Expendable Mobile Anti-Submarine Warfare Training Target (MK-39); MK-30 targets are recovered	
Assumptions Used for Analysis	Each activity includes vessel noise stressor	

A.1.3.2 Tracking Exercise – Surface

Activity Name	Activity Description	
Anti-Submarine Warfare		
Tracking Exercise – Surface	**Short Description:** Surface vessel crews search for, track, and detect submarines.	
Long Description	Surface ships search, detect, and track threat submarines to determine a firing position to launch a simulated torpedo and attack the submarine. A surface vessel operates at slow speeds while employing hull mounted and/or towed array sonar. Passive or active sonar is employed depending on the type of threat submarine, the tactical situation, and environmental conditions. The target for this exercise is a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, MK-30 Recoverable Training Target, or a submarine. Tracking exercise – surface could occur anywhere throughout the Offshore Area. This exercise may involve a single ship. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in any part of the Pacific Northwest Surface/Subsurface Operations Area depending on training requirements and available assets.	
Information Typical to the Event	**Platform:** Surface vessels **Systems:** Mid-frequency sonar, Nixie (countermeasure system) **Ordnance/Munitions:** None **Targets:** Submarine MK-30 or MK-39 Expendable Mobile Anti-Submarine Warfare Training Target **Duration:** 2–4 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** SLQ-25A Nixie, Portable Undersea Tracking Range (e.g., HF6, P2), surface ship sonar (SQS-53C) (e.g., MF1), mid-frequency projector (e.g., MF11), surface ship sonar (SQS-56) (e.g., MF2), vessel noise **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strike; military expended materials strike **Entanglement:** None **Ingestion:** Torpedo accessories, target fragments	
Detailed Military Expended Materials Information	MK-39 Expendable Mobile Anti-Submarine Warfare Training Target One Expendable Mobile Anti-Submarine Warfare Training Target (MK-39); MK-30 are recovered	
Assumptions Used for Analysis	Tracking exercise can occur in all locations in the Pacific Northwest Surface/Subsurface Operations Area. Submarines may provide service as the target.	

A.1.3.3 Tracking Exercise – Helicopter

Activity Name	Activity Description	
Anti-Submarine Warfare (ASW)		
Tracking Exercise – Helicopter	**Short Description:** Helicopter crews search for, track, and detect submarines.	
Long Description	This exercise involves helicopters using sonobuoys and dipping sonar to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a simulated torpedo and destroy the submarine. Sonobuoys are typically employed by a helicopter operating at altitudes below 3,000 feet (ft.) (914 meters [m]). Sonobuoys are deployed in specific patterns based on the expected threat submarine and specific water conditions. These patterns will cover many different size areas, depending on these two factors. Both passive and active sonobuoys are employed. For certain sonobuoys, tactical parameters of use may be classified. The dipping sonar is employed from an altitude of about 50 ft. (15 m) after the search area has been narrowed based on the sonobuoy search. Both passive and active sonar are employed. As the location of the submarine is further narrowed, a Magnetic Anomaly Detector may be used by the MH-60R to further confirm and localize the target's location. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 target, or a submarine and may be either non-evading and assigned to a specified track, or fully evasive depending on the state of training of the helicopter. This exercise may involve a single aircraft. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in any part of the Pacific Northwest Surface/Subsurface Operations Area depending on training requirements and available assets.	
Information Typical to the Event	**Platform:** One or more helicopters, other aircraft, one or more surface ships **Systems:** Mid-frequency helicopter dipping sonar, sonobuoys **Ordnance/Munitions:** None **Targets:** MK-30, MK-39, submarine **Duration:** 1–2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Helicopter dipping sonar (AQS-22) (e.g., MF4), Active sonobuoy (SSQ-62 DICASS) (e.g., MF5) **Energy:** None **Physical Disturbance and Strike:** helicopter strike (birds), MK-30 strike, military expended materials bottom disturbance **Entanglement:** parachutes/decelerators **Ingestion:** parachutes/decelerators	
Detailed Military Expended Materials Information	MK-39 Expendable Mobile Anti-Submarine Warfare Training Target Expended sonobuoys with decelerator/parachutes	
Assumptions Used for Analysis	None	

A.1.3.4 Tracking Exercise – Maritime Patrol Aircraft

Activity Name	Activity Description	
Anti-Submarine Warfare		
Tracking Exercise – Maritime Patrol Aircraft	**Short Description:** Maritime patrol aircraft crews search for, detect, and track submarines.	
Long Description	This exercise involves fixed-wing maritime patrol aircraft employing sonobuoys to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a simulated torpedo and destroy the submarine. Sonobuoys are typically employed by a maritime patrol aircraft operating at altitudes below 3,000 feet (ft.) (914 meters); however, sonobuoys may be released at higher altitudes. Sonobuoys are deployed in specific patterns based on the expected threat submarine and specific water conditions. Depending on these two factors, these patterns will cover many different size areas. Both passive and active sonobuoys are employed. For certain sonobuoys, tactical parameters of use may be classified. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 target, or a submarine. This exercise may involve a single aircraft. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in any part of the Pacific Northwest Surface/Subsurface Operations Area depending on training requirements and available assets.	
Information Typical to the Event	**Platform:** Maritime Patrol Aircraft (e.g., P-3C Orion or P-8A Poseidon), manned or unmanned fixed-wing aircraft **Systems:** Sonobuoys **Ordnance/Munitions:** None **Targets:** MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 recoverable target, or a live submarine **Duration:** 2–8 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Active sonobuoy (e.g., SSQ-62 DICASS) (e.g., MF5), vessel noise, aircraft noise **Energy:** Radar in periscope detection mode **Physical Disturbance and Strike:** Aircraft strike (seabirds only), vessel and in-water device strike, Military expended materials strike **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes	
Detailed Military Expended Materials Information	One Expendable Mobile Anti-Submarine Warfare Training Target (MK-39); MK-30 are recovered Expended sonobuoys with decelerator/parachutes	
Assumptions Used for Analysis	Tracking exercise can occur in all locations of the Pacific Northwest Surface/Subsurface Operations Area. Submarine may provide service as the target. If target is air-dropped, one parachute per target Altitudes are below 3,000 ft.; can be 400 ft. or lower.	

A.1.3.5 Tracking Exercise – Maritime Patrol Aircraft (Extended Echo Ranging Sonobuoys)

Activity Name	Activity Description	
Anti-Submarine Warfare		
Tracking Exercise – Maritime Patrol (Extended Echo Ranging Sonobuoys)	**Short Description:** Maritime patrol aircraft crews search, detect and track submarines using extended echo ranging and multistatic active coherent sonobuoys.	
Long Description	This exercise involves fixed-wing maritime patrol aircraft employing Improved Extended Echo Ranging and Multistatic Active Coherent sonobuoy systems to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a simulated torpedo and destroy the submarine. The Improved Extended Echo Ranging events use the SSQ-110A sonobuoy as an impulse source, while the Multistatic Active Coherent events utilize the SSQ-125 sonobuoy as a tonal source. Each exercise would include the use of approximately 10 SSQ-110A or SSQ-125 sonobuoys. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 target, or a submarine. This exercise may involve single or multiple aircraft.	
Information Typical to the Event	**Platform:** Maritime Patrol Aircraft **Systems:** Improved Extended Echo Ranging and multistatic active coherent sonobuoy systems **Ordnance/Munitions:** None **Targets:** MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 recoverable target, or a submarine **Duration:** 2–8 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** SSQ-125 Multistatic Acoustic Coherent (e.g., ASW2), underwater explosions, aircraft noise **Energy:** None **Physical Disturbance and Strike:** Aircraft strike (seabirds only), military expended materials strike **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes	
Detailed Military Expended Materials Information	One Expendable Mobile Anti-Submarine Warfare Training Target (MK-39); MK-30 are recovered Expended sonobuoys with decelerator/parachutes	
Assumptions Used for Analysis	If target is air-dropped, one parachute per target Altitudes for this activity can be as low as 400 feet	

A.1.4 ELECTRONIC WARFARE TRAINING

Electronic warfare is the mission area of naval warfare that aims to control use of the electromagnetic spectrum and to deny its use by an adversary. Typical electronic warfare activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices to defeat tracking systems.

A.1.4.1 Electronic Warfare Operations

Activity Name	Activity Description	
Electronic Warfare		
Electronic Warfare Operations	**Short Description:** Aircraft, surface vessel, and submarine personnel attempt to control portions of the electromagnetic spectrum used by enemy systems to degrade or deny the enemy's ability to take defensive actions.	
Long Description	Aircraft, surface ship, and submarine personnel attempt to control critical portions of the electromagnetic spectrum used by enemy systems to degrade or deny their ability to defend its forces from attack or recognize an emerging threat early enough to take defensive actions. Electronic Warfare Operations can be active or passive, offensive or defensive. Fixed wing aircraft employ active jamming and deception against enemy search radars to mask the friendly inbound strike aircraft mission. Surface vessels and submarines detect and evaluate enemy electronic signals from enemy aircraft or missile radars, evaluate courses of action concerning the use of passive or active countermeasures, then use vessel maneuvers and either chaff, flares, active electronic countermeasures, or a combination of them to defeat the threat.	
Information Typical to the Event	**Platform:** Fixed and rotary wing aircraft, surface combatant vessels, and submarines **Systems:** None **Ordnance/Munitions:** None **Targets:** Land based fixed/mobile threat emitters **Duration:** 1–2 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Vessel noise, aircraft noise **Energy:** None **Physical Disturbance and Strike:** Vessel strike, aircraft strike (seabirds only) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Chaff and Flares	
Assumptions Used for Analysis	All chaff and flares involved in this event are covered under Chaff exercise and Flare exercises, respectively	

A.1.5 MINE WARFARE TRAINING

Mine warfare training is the naval warfare area involving the detection, avoidance, and neutralization of mines to protect Navy ships and submarines, and offensive mine laying in naval operations. Mine warfare training includes mine detection and neutralization exercises.

A.1.5.1 Mine Neutralization – Explosive Ordnance Disposal

Activity Name	Activity Description	
Mine Warfare		
Mine Neutralization – Explosive Ordnance Disposal	**Short Description:** Personnel disable threat mines. Explosive charges are used.	
Long Description	Navy divers, typically explosive ordnance disposal personnel, disable threat mines with explosive charges to create a safe channel for friendly vessels to transit. Personnel detect, identify, evaluate, and neutralize mines in the water with an explosive device and may involve detonation of one or more explosive charges from 15 gram explosive charge (Shock Wave Action Generator) to 2.5 pounds of trinitrotoluene (TNT) equivalent. These operations are normally conducted during daylight hours for safety reasons.	
Information Typical to the Event	**Platform:** Rotary wing aircraft, Small boats **Systems:** None **Ordnance/Munitions:** Underwater detonation charges **Targets:** Mine shapes **Duration:** Up to 4 hours	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Under water explosions (e.g., E3), aircraft noise, vessel noise **Energy:** None **Physical Disturbance and Strike:** Seafloor **Entanglement:** None **Ingestion:** Target fragments	
Detailed Military Expended Materials Information	Target fragments	
Assumptions Used for Analysis	Charge placed anywhere in water column, including bottom Mine shapes will be recovered	

A.1.5.2 Submarine Mine Exercise

Activity Name	Activity Description	
Mine Warfare		
Submarine Mine Exercise	**Short Description:** Submarine crews practice detecting mines in a designated area.	
Long Description	Submarine crews use active sonar to detect and avoid mines or other underwater hazardous objects, while navigating restricted areas or channels, such as while entering or leaving port. This event trains submarine crews to detect and avoid mines. Training utilizes simulated minefields constructed of moored or bottom mine shapes, or instrumented mines that can record effectiveness of mine detection efforts. In a typical training exercise, submarine crews will use submarine high-frequency active sonar to locate and avoid the mine shapes. Each mine avoidance exercise involves one submarine operating submarine high-frequency active sonar for 6 hours to navigate through the training minefield. During mine warfare exercises submarines will expend several submarine launched expendable bathythermographs to determine water conditions affecting sonar performance.	
Information Typical to the Event	**Platform:** Submarine **Systems:** Submarine high-frequency active sonar **Ordnance/Munitions:** None **Targets:** Mine shapes **Duration:** 6 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Submarine high-frequency navigation and mine hunting sonar (e.g., HF1) **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strikes; seafloor device strike (bottom placed mine shapes) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Bathythermograph buoys	
Assumptions Used for Analysis	Assume three bathythermograph buoys per event	

A.1.5.3 Maritime Homeland Defense/Security Mine Countermeasures Integrated Exercise

Activity Name	Activity Description	
Mine Warfare		
Maritime Homeland Defense/Security Mine Countermeasures Integrated Exercise	**Short Description:** Maritime homeland defense/security mine countermeasures are naval mine warfare activities conducted at various ports and harbors, in support of maritime homeland defense/security.	
Long Description	Naval forces provide Mine Warfare capabilities to Department of Homeland Security led event. The three pillars of Mine Warfare, Airborne (helicopter), Surface (ships and unmanned vehicles), and Undersea (divers and unmanned vehicles) mine countermeasures will be brought to bear in order to ensure strategic U.S. ports remain free of mine threats. Various Mine Warfare sensors, which utilize active acoustics, will be employed in the detection, classification, and neutralization of mines. Along with traditional Mine Warfare techniques, such as helicopter towed mine countermeasures, new technologies (unmanned vehicles) will be utilized. Event locations and scenarios will vary according to Department of Homeland Security strategic goals and evolving world events.	
Information Typical to the Event	**Platform:** Surface combatant vessels, Small boats, Rotary wing aircraft **Systems:** Unmanned underwater and surface vehicles, various mine detection sensors (AN/AQS-20, AN/AQS-24) **Ordnance/Munitions:** Shock Wave Action Generator **Targets:** Temporary mine shapes **Duration:** Multiple days	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Vessel noise; aircraft noise (e.g., AN/SQQ 32, Unmanned underwater vehicle, MK 18 Swordfish, AN/PQS 2A, Marine Mammal Systems bottlenose dolphin bio-sonar), high-frequency mine hunting sonar (e.g., HF4) **Energy:** Magnetic influence mine sweeping **Physical Disturbance and Strike:** Vessel and in-water device strikes; seafloor device strike (bottom placed mine shapes); aircraft strike (seabirds only) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	Non-permanent mine shapes will be laid in various places on the bottom of Puget Sound. Shapes are varied, from about 1 meter (m) circular to about 2.5 m long by 1 m wide. They will be recovered using normal assets, with diver involvement. Programmatic analysis for acoustic effects only. For Air Quality, assumed 24 hours of helicopter, 24 hours of small boat, and 24 hours of surface combatant (destroyer) Operation.	

A.1.6 NAVAL SPECIAL WARFARE TRAINING

Naval special warfare and other Navy forces train to conduct military operations in five Special Operations mission areas: unconventional warfare, direct action, special reconnaissance, foreign internal defense, and counterterrorism. Naval special warfare training involves specialized tactics, techniques, and procedures, employed in training events that include: insertion/extraction operations using parachutes rubber boats, or helicopters; boat-to-shore and boat-to-boat gunnery; underwater demolition training; reconnaissance; and small arms training.

A.1.6.1 Personnel Insertion/Extraction – Submersible

Activity Name	Activity Description	
Naval Special Warfare		
Personnel Insertion/Extraction – Submersible	**Short Description:** Military personnel train for covert insertion and extraction into target areas using submersibles.	
Long Description	Military personnel train for covert insertion and extraction into target areas using submersibles. Often, an undersea delivery vehicle, similar to a “mini-sub,” may be used to transfer the personnel to their objective near shore. These operations will vary in length depending on the transportation method and systems being used. Training may include navigation runs in Puget Sound that may be conducted in coordination with other training activities.	
Information Typical to the Event	**Platform:** Sea, Air, Land Delivery Vehicle **Systems:** None **Ordnance/Munitions:** None **Targets:** None **Duration:** 2–8 hours	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.1.6.2 Personnel Insertion/Extraction – Non-Submersible

Activity Name	Activity Description	
Naval Special Warfare		
Personnel Insertion/Extraction – Non-Submersible	**Short Description:** Military personnel train for covert insertion and extraction into target areas using rotary wing aircraft, fixed-wing aircraft (insertion only), or small boats.	
Long Description	Personnel train to approach or depart an objective area using various transportation methods and tactics. These operations train forces to insert and extract personnel and equipment day or night. Tactics and techniques employed include insertion from aircraft by parachute, by rope, or from low, slow-flying helicopters from which personnel jump into the water. Parachute training is required to be conducted on surveyed drop zones to enhance safety. Insertion and extraction methods also employ small inflatable boats.	
Information Typical to the Event	**Platform:** Fixed and rotary wing aircraft **Systems:** None **Ordnance/Munitions:** None **Targets:** None **Duration:** 2–8 hours	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.1.7 OTHER TRAINING

A.1.7.1 Precision Anchoring

Activity Name	Activity Description	
Other Training		
Precision Anchoring	**Short Description:** Releasing of anchors in designated locations.	
Long Description	Vessels navigate to a pre-planned position and deploy the anchor. The vessel uses all means available to determine its position when anchor is dropped to demonstrate calculating and plotting the anchor's position within 100 yards of center of planned anchorage.	
Information Typical to the Event	**Platform:** All surface vessels **Systems:** None **Ordnance/Munitions:** None **Targets:** None **Duration:** Up to 1 hour	**Location:** Inland Waters (Naval Station Everett anchorage area, Indian Island anchorage area)
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** Vessel strike, seafloor device strike (anchor) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Material Information	None	
Assumptions Used for Analysis	None	

A.1.7.2 Small Boat Attack

Activity Name	Activity Description	
Other		
Small Boat Attack	**Short Description:** Small boat crews engage pierside surface targets with small-caliber weapons. Only blank rounds are fired.	
Long Description	A single activity consists of multiple days of training. For analysis in this EIS, a 3-day scenario is assumed. On the first day, blanks will be fired from a small-caliber machine gun, mounted on a high-speed boat used by Navy security forces. The second day will consist of test firing multiple crew-serve and hand-held small-caliber weapons, all with blank ammunition. Some rounds will be fired from both the high-speed boat and from a Navy surface ship moored at a Navy pier. The third day will be the full training exercise. This consists of a high-speed attack vessel running directly at the Navy pier where the simulated target surface ship is moored. Duration of firing will be approximately 2 hours with a total of 1,000 rounds fired the first day, and a duration of 1.5 hours with a total of 1,000 rounds fired the second day. The final day will have a duration of approximately 30 minutes, with 1,000 rounds fired. Typical firing patterns are 3–30 round bursts, assess target, and then fire again. Multiple crew members will be given a chance to fire the weapons.	
Information Typical to the Event	**Platform:** Small boats or watercraft **Systems:** **Ordnance/Munitions:** Small-caliber (non-explosive) **Targets:** High-performance small boats **Duration:** Varies	**Location:** Inland Waters (Naval Station Everett, Naval Base [NAVBASE] Kitsap Bangor, NAVBASE Kitsap Bremerton)
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Airborne noise from small arms fire **Energy:** None **Physical Disturbance and Strike:** Vessel strike, military expended material strike (casings) **Entanglement:** None **Ingestion:** Casings	
Detailed Military Expended Material Information	Casings	
Assumptions Used for Analysis	At locations where a security barrier is present, and sea lions may be hauled out on the barrier, the security barrier will be pulled fully open to remove haul out opportunities. During Day 1 training, all firing will occur at least 250 feet away from the security barrier.	

A.1.7.3 Intelligence, Surveillance, Reconnaissance

Activity Name	Activity Description	
Other Training Exercises		
Intelligence, Surveillance, Reconnaissance (ISR)	**Short Description:** Maritime patrol aircraft (MPA) use all available sensors to collect data on threat vessels.	
Long Description	MPA use all available sensors to collect data on threat vessels. Passive sonobuoys are used to collect and analyze acoustic data, and photographic equipment is used to document the vessel with visual information.	
Information Typical to the Event	**Platform:** P-3, EP-3, P-8, EA-18G, EA-6B **Systems:** Fixed wing aircraft **Ordnance/Munitions:** None **Targets:** Targets of Opportunity **Duration:** 2–8 hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Aircraft noise **Energy:** None **Physical Disturbance and Strike:** Aircraft strike (birds only) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	ISR training is conducted by MPA in Warning Area 237 and the Pacific Northwest Operating Area. Activities typically last 6 hours. P-3 aircrews use a variety of intelligence gathering and surveillance methods, including visual, infrared, electronic, radar, and acoustic. EP-3, EA-18G, and EA-6B crews conduct ISR training as well, but to a lesser extent than P-3C crews. P-8 aircraft are the P-3 replacement MPA.	

A.1.7.4 Search and Rescue

Activity Name	Activity Description	
Other Training Exercises		
Search and Rescue	**Short Description:** Helicopter crews rescue military personnel at sea.	
Long Description	Helicopter crews rescue military personnel at sea. Helicopters fly below 3,000 feet and locate personnel to be rescued. Flares are expended during training.	
Information Typical to the Event	**Platform:** Helicopters (H-60); small boats **Systems:** None **Ordnance/Munitions:** Flares **Targets:** None **Duration:** 2–3 hours	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Vessel noise, aircraft noise **Energy:** None **Physical Disturbance and Strike:** Vessel strike, aircraft strike (birds only) **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Expended flares	
Assumptions Used for Analysis	This activity involves a helicopter landing and simulated extraction of a survivor (typically one of the helicopter crewmembers). The search and rescue helicopter, an H-60, approaches the survivor, hovers, recovers the survivor, and then departs the area with the survivor onboard.	

A.1.7.5 Surface Ship Sonar Maintenance

Activity Name	Activity Description	
Other		
Surface Ship Sonar Maintenance	**Short Description:** Pierside and at-sea maintenance of sonar systems.	
Long Description	This scenario consists of surface combatant vessels performing periodic maintenance to the AN/SQS-53 or AN/SQS-56 sonar while in port or at sea. This maintenance takes up to 4 hours. Surface vessels operate active sonar systems for maintenance while pierside however, sonar maintenance will occur pierside or at-sea in the open ocean.	
Information Typical to the Event	**Platform:** Surface combatant vessels **Systems:** Hull mounted sonar systems (AN/SQS-53 or AN/SQS-56) **Ordnance/Munitions:** None **Targets:** None **Duration:** Up to 4 hours	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Surface ship sonar (SQS-53C, SQS-56) (e.g., MF1, MF2), Vessel noise **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.1.7.6 Submarine Sonar Maintenance

Activity Name	Activity Description	
Other-Maintenance		
Submarine Sonar Maintenance	**Short Description:** Pierside and at-sea maintenance of sonar systems.	
Long Description	A submarine performs periodic maintenance on the mid-frequency and high-frequency sonar systems while in port or at sea. Submarines conduct maintenance to their sonar systems in shallow water near their homeport however, sonar maintenance could occur anywhere as the system's performance may warrant	
Information Typical to the Event	**Platform:** Submarines **Systems:** Mid- and high-frequency submarine sonar system **Ordnance/Munitions:** None **Targets:** None **Duration:** 45 minutes–1 hour	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Submarine sonar (e.g., MF3, HF1) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.2 NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT TESTING ACTIVITIES

Naval Undersea Warfare Center (NUWC) Division, Keyport testing activities are aligned with its mission of providing test and evaluation services and expertise to support the Navy's evolving manned and unmanned vehicle program activities. NUWC Division, Keyport has historically provided facilities and capabilities to support testing of torpedoes, other unmanned vehicles, submarine readiness, diver training, and similar activities that are critical to the success of undersea warfare. Each major category of NUWC Division, Keyport activities is described below.

A.2.1 TORPEDO TESTING

A.2.1.1 Torpedo Non-Explosive Testing

Activity Name	Activity Description	
Torpedo Testing		
Torpedo Non-Explosive Testing	**Short Description:** Test of a non-explosive torpedo against a target.	
Long Description	Torpedoes are the primary undersea warfare weapons used by surface ships, aircraft, and submarines. The guidance systems of these weapons may be autonomous or controlled from the launch platform through a variety of 'links' (e.g., electric, fiber optic, acoustic). The autonomous guidance systems use either 'passive' acoustics, detecting the sound energy emitted from the target, or 'active' acoustics, finding the target with sonar and using the received echoes for guidance. Torpedoes tested in this activity contain no explosives. Propulsion Systems include thermal, electrical, or chemical propulsions systems. Thermal propulsion systems are powered by motors that use different types of fuels (e.g., Otto Fuel II, rocket, diesel, jet fuels) that exhaust combustion products into the water column; other closed cycle thermal propulsion systems produce only heat emissions. Electric propulsion systems are powered by closed cycle motors using batteries (e.g., lithium thionyl, lithium ion, lead acid, silver zinc, and nickel hydride); only heat emissions are produced. Chemical propulsion systems are usually based on a lithium boiler that is a closed cycle system; only heat energy is transferred into the environment. The torpedo test vehicle is deployed by a support craft or other means. The vehicle searches for its intended target, or runs a planned geometry. Each test, including set up and retrieval may last several hours. The vehicle run time may be 10 minutes. Following the test, the vehicle is retrieved for post-test analysis. Most targets are retrieved, while some may be expended. The objective is to retrieve all vehicles, targets and related materials.	
Information Typical to the Event	**Platform:** Support craft/other **Systems:** Sonar, torpedoes, range tracking pingers, AUV/ROV/UUVs, submersible, concepts and prototypes (including experimental vehicles) **Ordnance/Munitions:** Torpedoes (non-explosive) **Targets:** EMATT, MK-30, submarine, or surface combatant **Duration:** Assume 8 hours for all torpedo tests	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Torpedo (e.g., TORP1, TORP2), Mid-frequency sonar (e.g., ASW3, ASW4, MF5, MF10), vessel noise (support craft) **Energy:** None **Physical Disturbance and Strike:** Vessel strike, in-water device strike **Entanglement:** Torpedo guidance wire, flex hose **Ingestion:** None	
Detailed Military Expended Materials Information	Torpedo guidance wire, flex hose, aluminum doors, lead dropper weights, fiber optic guidance wire, expendable targets, nose cap, release wire	
Assumptions Used for Analysis	All torpedo vehicles will be recovered. Support craft are on site and usually stationary during the test, running for 30 percent of the entire 8-hour scenario including transit.	

A.2.2 AUTONOMOUS AND NON-AUTONOMOUS VEHICLES

A.2.2.1 Unmanned Underwater Vehicle Testing

Activity Name	Activity Description	
Autonomous and Non-Autonomous Vehicles		
Unmanned Underwater Vehicle Testing	**Short Description:** Unmanned underwater vehicles are autonomous or remotely operated vehicles with a variety of different payloads used for various purposes.	
Long Description	Autonomous underwater vehicle launch and retrieval methods are highly variable because of the differences in autonomous vehicle technology involved and of the variety of autonomous vehicle uses. Non-autonomous or remotely controlled vehicles are also used and tested. These may be tethered like remotely operated vehicles (ROVs) or remotely controlled vehicles that have radio links. Some vehicles may be used to transport personnel (whether inside or outside the vehicle). They may have both manual and autonomous control capabilities. Many autonomous vehicles have multiple test objectives or payloads (such as cameras and side-scan or multibeam sonar) onboard so that numerous tests can be run during a single test activity. UUV sensors may be tested to ensure they can detect, classify, and localize non-explosive mine shapes among rocky outcrops or non-mine shapes. These sensors may also be associated with a vessel, or placed before a single non-explosive mine shape or mine field is put in place. The mine shapes themselves may be tested to ensure they deploy as required and fleet operators may be trained in mine field placement. Propulsion Systems include thermal, electrical, or chemical propulsions systems as described above under A.2.1.1 (Torpedo Non-Explosive Testing). The UUV test vehicle is lowered into or onto the water from a support craft or from a pier. The vehicle will propel itself through the water or by crawling across the bottom to complete the test objectives, which could include deployment or recovery of a payload, sonar or other sensor use, or completion of a propulsion test.	
Information Typical to the Event	**Platform:** Unmanned vehicles, support craft/other **Systems:** Sonar, underwater communications **Ordnance/Munitions:** none **Targets:** Include but not limited to mobile, or Fleet vessel **Duration:** Assume 8 hours for all UUV tests, though tests may continue for up to 40 hours, and infrequently some may operate continuously for multiple months	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Synthetic aperture sonar (e.g., SAS2), acoustic modems (e.g., M3) **Energy:** None **Physical Disturbance and Strike:** In-water device strike **Entanglement:** Torpedo guidance wire **Ingestion:** None	
Detailed Military Expended Materials Information	Torpedo guidance wire, flex hose, aluminum doors, lead dropper weights, fiber optic guidance wire, expendable targets, nose cap, release wire	
Assumptions Used for Analysis	All test systems will be recovered. Support craft include two rigid-hull inflatable boats, running at 50 percent power for the entire 8-hour scenario.	
Scenarios covered	General and Experimental Test Vehicle, Low Frequency Broad Band Testing, UUV Operations (various), Mine Detections Operations	

A.2.2.2 Unmanned Aircraft System

Activity Name	Activity Description	
Autonomous and Non-Autonomous Vehicles		
Unmanned Aircraft System	**Short Description:** Unmanned aircraft systems (UASs) are remotely piloted or self-piloted (i.e., preprogrammed flight pattern) aircraft that include fixed wing, rotary-wing, and other vertical takeoff vehicles. They can carry cameras, sensors, communications equipment, or other payloads.	
Long Description	UASs are remotely piloted or self-piloted (i.e., preprogrammed flight pattern) aircraft that include fixed wing, rotary-wing, and other vertical takeoff vehicles. They can carry cameras, sensors, communications equipment, or other payloads. UASs can vary in size up to approximately 10 feet (ft.) (3 meters) in length, with gross vehicle weights of a couple hundred pounds. Propulsion types can range from traditional turbofans, turboprops, and piston engine-driven propellers, to electric motor-driven propellers powered by rechargeable batteries (lead-acid, nickel-cadmium, and lithium ion), photovoltaic cells, and/or hydrogen fuel cells. The UAS test vehicle is deployed by a support craft or other means from a ship or from shore, flying within the test area in accordance with Federal Aviation Administration (FAA) regulations over a duration of 2–8 hours. The UAS usually flies at altitudes less than 3,000 ft. in accordance with FAA regulations.	
Information Typical to the Event	**Platform:** Unmanned aerial vehicles **Systems:** None **Ordnance/Munitions:** None **Targets:** None **Duration:** 2–8 hours	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** Aircraft strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	The UAS may spend 25 percent of its flight time above 3,000 ft. and 25 percent of its time outside 3 nautical miles of the coastline.	

A.2.2.3 Unmanned Surface Vehicle Testing

Activity Name	Activity Description	
Autonomous and Non-Autonomous Vehicles		
Unmanned Surface Vehicle Testing	**Short Description:** Unmanned surface vehicles are primarily autonomous systems designed to augment current and future platforms to help deter maritime threats. They employ a variety of sensors designed to extend the reach of manned ships.	
Long Description	Unmanned surface vehicles (USV) can include remotely operated craft (semi-submersible, plane hull, semi-plane hull, etc.) and test vehicles. During testing, they can operate autonomously, semi-autonomously, or non-autonomously. Non-autonomous or remotely controlled vehicles may be tethered like remotely operated vehicles (ROVs) or remotely controlled via radio link. USVs may have multiple test objectives and/or payloads (such as cameras and sonar) onboard so that numerous tests can be executed during a single testing activity. USVs may be used in conjunction with UUVs and UAVs to meet test objectives. USV launch and retrieval methods are highly variable because of the differences in vehicle type and size. USV test vehicle launch methods include, lowering onto the water from a support craft or pier, deploying from another craft, or launching from a boat ramp. The vehicle will propel itself through the water to complete the test objectives, which could include deployment and/or recovery of a payload, sonar or other sensor use, or completion of a propulsion test.	
Information Typical to the Event	**Platform:** Unmanned vehicles, support craft/other **Systems:** Sonar, electronic surveillance, infrared **Ordnance/Munitions:** none **Targets:** Include but not limited to mobile, or Fleet vessel **Duration:** Assume 8 hours for all USV tests, though tests may continue for up to 40 hours, and infrequently some may operate continuously for multiple months	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Synthetic aperture sonar (e.g., SAS2), acoustic modems (e.g., M3) **Energy:** None **Physical Disturbance and Strike:** In-water device strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	All test systems will be recovered. Support craft include two rigid-hull inflatable boats, running at 50 percent power for the entire 8-hour scenario.	
Scenarios covered	General and Experimental Test Vehicle, Low Frequency Broad Band Testing, USV Operations (various), Mine Detections Operations	

A.2.3 FLEET TRAINING/SUPPORT

A.2.3.1 Cold Water Training

Activity Name	Activity Description	
Fleet Training/Support		
Cold Water Training	**Short Description:** Fleet training for divers in a cold water environment and other diver training related to Navy divers supporting range operations.	
Long Description	Fleet training for divers in a cold water environment and other diver training related to Navy divers supporting range operations. Acoustic systems may be used in diver training. These fleet activities in the Naval Sea Systems Command Naval Undersea Warfare Center Division, Keyport Range Complex are non-acoustic and do not include the use of submarine hull-mounted active sonar.	
Information Typical to the Event	**Platform:** Support craft **Systems:** None **Ordnance/Munitions:** None **Targets:** None **Duration:** Assume 8 hours for all events, though they may continue for up to 40 hours, and infrequently some may operate intermittently for multiple consecutive months	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	If used, support craft may run for 100 percent of an 8-hour event.	

A.2.3.2 Post-Refit Sea Trial

Activity Name	Activity Description	
Fleet Training/Support		
Post-Refit Sea Trial	**Short Description:** Following periodic maintenance periods or repairs, sea trials are conducted to evaluate submarine propulsion, sonar systems, and other mechanical tests.	
Long Description	Testing activities are conducted throughout the life of a Navy submarine to verify performance and mission capabilities. Sea trials are conducted following periodic maintenance or repairs. A typical test may include a submarine operating at full power and subjected to high-speed runs, steering tests, and other mechanical tests.	
Information Typical to the Event	**Platform:** Submarine, support craft **Systems:** All internal submarine systems **Ordnance/Munitions:** None **Targets:** None **Duration:** Typically 8 hours	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency active sources (e.g., MF10), acoustic modems (e.g., M3) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	One submarine	

A.2.3.3 Anti-Submarine Warfare Testing

Activity Name	Activity Description	
Fleet Training/Support		
Anti-Submarine Warfare (ASW) Testing	**Short Description:** Ships and their supporting platforms (e.g., helicopters, unmanned aerial vehicles) detect, localize, and prosecute submarines or other training targets.	
Long Description	Fleet activities that occur within the Range Complex may involve the use of ships. Such activities provide sailors the opportunity to train with actual Naval assets in a controlled range environment. Surface ships are outfitted with navigation tracking systems so that their location on the instrumented range can be very accurately determined. A typical activity involves surface ships and the range use of active acoustics to support navigation (tracking, depth sensors, etc.), detection, classification, and localization of underwater targets (submarines or submarine simulators) in a realistic environment.	
Information Typical to the Event	**Platform:** Surface combatants, submarines **Systems:** Active sonar, tracking, underwater communications **Ordnance/Munitions:** Sonobuoys **Targets:** Include but not limited to stationary, mobile, or Fleet vessel **Duration:** Assume 16 hours for all events, though they may continue for up to 48 hours, and infrequently some may operate intermittently for multiple consecutive weeks	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency sources (e.g., MF10), mid-frequency high duty-cycle sources (e.g., MF11), vessel and simulated vessel noise **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strikes **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.2.4 MAINTENANCE AND MISCELLANEOUS

A.2.4.1 Side Scan/Multibeam

Activity Name	Activity Description	
Maintenance and Miscellaneous		
Side Scan/ Multibeam Sonar	**Short Description:** Side Scan/Multibeam systems associated with a vessel or unmanned undersea vehicle (UUV) are tested to ensure they can detect, classify, and localize targets in a real world environment.	
Long Description	Side-scan and multibeam sonar can be used for mapping, as well as detection, classification, and localization of items on the sea floor such as cabling, shipwrecks, and mine shapes. It is typically very high frequency using multiple frequencies at one time with a very directional focus. Side-scan and multibeam sonar systems may be towed or mounted on a test vehicle or ship. Inert mines themselves may be tested to ensure they deploy as required and Fleet operators may be trained in mine field placement. During inert mine detection, classification, and localization activities an inert mine shape may be temporarily deployed. This may include one shape or a field of shapes. All mine targets in the proposed range extension areas would be temporary; they would not be permanently mounted on the bottom and could be removed when they were no longer necessary for testing activities, which could be up to 2 years. Several target shapes may be deployed in the surf-zone test area in water greater than 10 feet (ft.) (3 meters) deep; additional targets would be placed in depths of less than 10 ft. (3 m). Inert mine shapes may be made of many composite materials and are often put on the bottom or float in the water column above an anchor, often in groups. A series of inert mine fields can be laid to test the detection, classification, and localization capability of the system under test.	
Information Typical to the Event	**Platform:** UUV, surface vessel **Systems:** Very high frequency sonar **Ordnance/Munitions:** None **Targets:** Including but not limited to bottom, moored, and floating targets. **Duration:** Assume 8 hours for all events, though they may continue for up to 40 hours, and infrequently some may operate intermittently for multiple consecutive months	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.2.4.2 Non-Acoustic Tests

Activity Name	Activity Description	
Maintenance and Miscellaneous		
Non-Acoustic Tests	**Short Description:** These tests involve non-acoustic sensors. Non-acoustic sensors may also gather other forms of environmental data.	
Long Description	These tests involve non-acoustic sensors. Non-acoustic sensors may also gather other forms of environmental data. An example of a non-acoustic sensor is an oxygen sensor that detects the level of dissolved oxygen in the water with respect to depth. Sensors for conductivity and temperature with respect to depth are used frequently to improve tracking with updated sound velocity profiles from raw data. Magnetic sensors are non-acoustic sensors that can be placed on the bottom to detect passing vessels. Non-acoustic sensors may also be put on an unmanned undersea vehicle as a payload.	
Information Typical to the Event	**Platform:** Various **Systems:** Various non-acoustic systems **Ordnance/Munitions:** None **Targets:** None **Duration:** Assume 8 hours for all events, though they may continue for up to 40 hours, and infrequently some may operate intermittently for multiple consecutive months	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.2.5 ACOUSTIC COMPONENT TEST

A.2.5.1 Countermeasures Testing

Activity Name	Activity Description	
Acoustic Component Test		
Countermeasures Testing	**Short Description:** Includes testing of two types of countermeasures: those that emit active acoustic energy of varying frequencies into the water to mimic the characteristics of a target so that the actual threat or target remains undetected; and those that would detect, localize, track, and attack incoming weapons.	
Long Description	Countermeasures, which may take many different forms and represent a range of tactics, attempt to disrupt an attack intended for a target. Underwater, a countermeasure may emit sound that is louder than the target or in a different location that is similar to the target, causing the attacker to detour away from the target. Additionally, it could be something that looks like a threat or mimics the magnetic characteristics of a target, so that the actual threat or target remains undetected. By design, countermeasures emit active acoustic energy of varying frequencies into the water.	
Information Typical to the Event	**Platform:** Submarine **Systems:** Acoustic countermeasures **Ordnance/Munitions:** None **Targets:** Various **Duration:** Assume 8 hours for all events, though they may continue for up to 40 hours, and infrequently some may operate intermittently for multiple consecutive months	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency acoustic device countermeasures (ASW4) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Expendable acoustic countermeasures	
Assumptions Used for Analysis	None	

A.2.5.2 Acoustic Test Facility

Activity Name	Activity Description	
Acoustic Component Test		
Acoustic Test Facility	**Short Description:** Various acoustic component testing and calibration is conducted in a controlled experimental environment based on periodicity and is also conducted on modified, upgraded, and experimental devices.	
Long Description	Acoustic Test Facility is used to calibrate and characterize transducers and hydrophones, and conduct performance testing of modified, upgraded, and experimental acoustic devices in a controlled yet realistic environment. Calibration and testing is also conducted for maintenance purposes based on periodicity.	
Information Typical to the Event	**Platform:** Various **Systems:** Various acoustic systems **Ordnance/Munitions:** None **Targets:** None **Duration:** Assume 8 hours for all tests; some may last 10 minutes, while others may continue intermittently for several days.	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Low-frequency sources (LF4), mid-frequency sources (MF9), high-frequency sources (HF6), very high-frequency sources (VHF2) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.2.5.3 Pierside Integrated Swimmer Defense

Activity Name	Activity Description	
Acoustic Component Test		
Pierside Integrated Swimmer Defense	**Short Description:** Swimmer defense testing ensures that systems can effectively detect, characterize, verify, and engage swimmer and diver threats in harbor environments.	
Long Description	Swimmer defense testing includes testing of systems to determine if they can effectively detect, characterize, verify, and engage swimmer/diver threats in harbor environments. Swimmer and diver threats are detected with high-frequency sonar. The threats are then warned to exit the water through the use of underwater voice communications. Under operational conditions, if the threat does not comply, non-lethal diver deterrent air guns are used against the threat; however, airguns would not be used under proposed testing conditions. Surface loudhailers are also used during the test. Event duration is 14 days, with intermittent periods of use for each system during this time.	
Information Typical to the Event	**Platform:** None **Systems:** High-frequency sonar; surface loudhailers **Ordnance/Munitions:** None **Targets:** None **Duration:** 14 days	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Low-frequency sonar (L4), mid-frequency sonar (MF8), swimmer detection sonar (SD1) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	**Other Sensors:** Surface ship protection systems (e.g., communications systems, loudhailers, swimmer deterrents)	

A.3 NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION DETACHMENT PUGET SOUND TESTING ACTIVITIES

The Naval Sea Systems Command, Naval Surface Warfare Center, Carderock Division (NSWCCD) Detachment Puget Sound testing activities are aligned with its mission to provide research, development, test and evaluation, analysis, acquisition support, in-service engineering, logistics and integration of surface and undersea vehicles and associated systems; develop and apply science and technology associated with naval architecture and marine engineering; and provide support to the maritime industry. Carderock is the Navy's center of excellence for ships and ship systems. Carderock is the full-spectrum research and development, test and evaluation, engineering, and Fleet support organization for the Navy's ships, submarine, military watercraft, and unmanned vehicles.

NSWCCD Detachment Puget Sound is located in the NAVBASE Kitsap Bangor. Its activities are conducted in the Hood Canal within the parameters of the Dabob Bay Range Complex Site and alternately as required in Carr Inlet. Activities and support include engineering, technical, operations, diving, and logistics required for the RDT&E associated with: Advanced Technology Concepts, Engineering and Proofing, Experimental Underwater Vehicles, Systems, Subsystems and Components Specialized Underwater Systems, Equipment, Tools and Hardware Acoustic Data Acquisition, Analysis and Measurement Systems (required to measure U.S. Navy Acoustic Signatures). These activities can be broken down into two major testing categories to include System, Subsystem and Component Acoustic Testing (with three variants) and Proof of Concept Testing. Typical RDT&E activity descriptions for each major category and variant are provided below.

A.3.1 SYSTEM, SUBSYSTEM AND COMPONENT TESTING

A.3.1.1 Pierside Acoustic Testing

Activity Name	Activity Description	
System, Subsystem, and Component Testing		
Pierside Acoustic Testing	**Short Description:** Operating autonomous underwater vehicle (AUV), remotely operated vehicle (ROV), unmanned undersea vehicle (UUV), submersibles/Concepts and Prototypes (including experimental vehicles, systems, equipment, tools and hardware) underwater in a static or dynamic condition within 500 yards (yd.) of an instrumented platform moored pierside.	
Long Description	Operating AUV, ROV, UUV, submersibles/Concepts and Prototypes (including experimental vehicles, systems, equipment, tools and hardware) underwater in a static or dynamic condition within 500 yd. of an instrumented platform moored pierside. The instrumented platform will have onboard acoustic measurement data acquisition and analysis systems, and onboard/over-the-side hydrophones (some sitting on the sea floor), and surface tracking vessels. Systems will be exercised to obtain static and short distance operational and acoustic measurements of all subsystems and components including motors, controllers, actuators, communication and devices, and forward, side and bottom looking sonar used for navigation and mission objectives. A separate tracking boat and multiple boats may be used as required for tracking, observation and safety. Diving services may be required.	
Information Typical to the Event	**Platform:** Support craft, barge, pierside (only at Naval Base Kitsap Bangor) **Systems:** AUV, ROV, UUV, submersibles **Ordnance/Munitions:** None **Targets:** Targets will remain installed on the bottom until test period is completed and will be recovered. **Duration:** Varies, dependent on test parameters.	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency projector (e.g., MF10), low-frequency projectors (e.g., LF5) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Targets will remain installed on the bottom until test period is completed and will be recovered.	
Assumptions Used for Analysis	Varies dependent on equipment tested.	

A.3.1.2 Performance Testing at Sea

Activity Name	Activity Description	
System, Subsystem and Component Testing		
Performance Testing at Sea	**Short Description:** Operating autonomous underwater vehicle (AUV), remotely operated vehicle (ROV), unmanned undersea vehicle (UUV), submersibles/Concepts and Prototypes underwater at sea. Systems will be exercised to obtain operational performance measurements of all subsystems and components used for navigation and mission objectives.	
Long Description	Operating AUV, ROV, UUV, submersibles/Concepts and Prototypes (including experimental vehicles, systems, equipment, tools and hardware) underwater in a static or dynamic condition while underway in Puget Sound. The instrumented platform will have onboard acoustic measurement data acquisition and analysis systems, onboard/over-the-side hydrophones (some sitting on the sea floor), and surface tracking vessels. Systems will be exercised to obtain operational performance measurements of all subsystems and components including motors, controllers, actuators, communication and devices, and forward, side and bottom looking sonar used for navigation and mission objectives. A separate tracking boat and multiple boats may be used as required for tracking, observation and safety. Diving services may be required.	
Information Typical to the Event	**Platform:** Support craft, barge **Systems:** AUV, ROV, UUV, submersibles **Ordnance/Munitions:** None **Targets:** Targets will remain installed on the bottom until test period is completed and will be recovered. **Duration:** Varies, dependent on test parameters.	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Acoustic modems (e.g., M3), synthetic aperture sonar (e.g., SAS2) **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strikes **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Targets will remain installed on the bottom until test period is completed and will be recovered.	
Assumptions Used for Analysis	Varies, dependent on equipment tested.	

A.3.1.3 Development Training and Testing

Activity Name	Activity Description	
System, Subsystem and Component Testing		
Development Training and Testing	**Short Description:** Operating autonomous underwater vehicle (AUV), remotely operated vehicle (ROV), unmanned undersea vehicle (UUV), submersibles/Concepts and Prototypes underwater at sea. Systems will be exercised to validate development and to provide operator familiarization and training with all subsystems and components used for navigation and mission objectives.	
Long Description	Operating AUV, ROV, UUV, submersibles/Concepts and Prototypes (including experimental vehicles, systems, equipment, tools and hardware) underwater in a static or dynamic condition at-sea. The instrumented platform will have onboard acoustic measurement data acquisition and analysis systems, and onboard/over-the-side hydrophones (some sitting on the sea floor), and surface tracking vessels. Systems will be exercised to validate development and to provide operator familiarization and training with all subsystems and components including motors, controllers, actuators, communication and devices, and forward, side and bottom looking sonar used for navigation and mission objectives. A separate tracking boat and multiple boats may be used as required for tracking, observation and safety. Diving services may be required.	
Information Typical to the Event	**Platform:** Support craft, barge **Systems:** AUV, ROV, UUV, submersibles **Ordnance/Munitions:** None **Targets:** Targets will remain installed on the bottom until test period is completed and will be recovered. **Duration:** Varies, dependent on test parameters.	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projectors (e.g., HF6), acoustic modems (e.g., M3) **Energy:** None **Physical Disturbance and Strike:** Vessel and in-water device strikes **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Targets will remain installed on the bottom until test period is completed and will be recovered.	
Assumptions Used for Analysis	Varies, dependent on equipment tested.	

A.3.2 PROOF OF CONCEPT TESTING

A.3.2.1 Proof-of-Concept Testing

Activity Name	Activity Description	
Proof-of-Concept Testing		
Proof-of-Concept Testing	**Short Description:** Design, fabrication and installation of unique hardware and towing configurations in support of various surface and underwater demonstrations as proof-of-concept.	
Long Description	Design, fabrication and installation of unique hardware and towing configurations in support of various surface and underwater demonstrations as proof-of-concept. Example: Adapt a fixture to a test platform which will simulate a dry-deck shelter, at 40 feet depth, and prove something can be safely deployed and recovered as it and the test platform moves through the water at slow speed. The instrumented platform may have a suite of Shipboard Deployed Equipment which will be used for monitoring, communication and control of the deployed systems. Can involve use of autonomous underwater vehicles (AUVs)/ remotely operated vehicles (ROVs)/unmanned undersea vehicles (UUVs), submersibles, Concepts and Prototypes (including experimental vehicles, systems, equipment, tools and hardware). Systems will be exercised to prove concept(s) and integrate with all required subsystems and components including motors, controllers, actuators, communication and devices, and forward, side and bottom looking sonar used for navigation and mission objectives. A separate tracking boat and multiple boats will be used for tracking, observation and safety. Diving services may be required.	
Information Typical to the Event	**Platform:** Support craft (usually a tug boat), barges, and other support boats as required **Systems:** Various such as AUV/ROV/UUVs, submersible, Concepts and Prototypes (including experimental vehicles, systems, equipment, tools and hardware.) **Ordnance/Munitions:** None **Targets:** Targets maybe required to be installed in the testing area **Duration:** Varies	**Location:** Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projector (e.g., HF6), acoustic modem (e.g., M3), synthetic aperture sonar (e.g. SAS2) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	Targets will remain installed on the bottom until test period is completed (up to 36 months) and will be recovered.	
Assumptions Used for Analysis	Varies dependent on equipment tested.	

A.4 NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION, SOUTHEAST ALASKA ACOUSTIC MEASUREMENT FACILITY TESTING ACTIVITIES

The Southeast Alaska Acoustic Measurement Facility (SEAFAC) is the Navy's only west coast asset for making high fidelity passive acoustic signature measurements. SEAFAC includes directive line arrays, data collection and processing systems for real-time data analysis and signature evaluation.

As the Navy's primary acoustic engineering measurement facility in the Pacific, SEAFAC provides the capability to perform RDT&E evaluations to determine the sources of radiated acoustic noise, to assess vulnerability, and to develop quieting measures.

The facility consists of a site to collect acoustic signatures of submerged submarines and surface vessels underway, and a unique static site to measure acoustic signatures of motionless (static) submerged submarines with various onboard machinery secured or under unloaded operation.

A.4.1 NAVAL SURFACE WARFARE CENTER, CARDEROCK DIVISION, SOUTHEAST ALASKA ACOUSTIC FACILITY

A.4.1.1 Surface Vessel Acoustic Measurement

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Surface Vessel Acoustic Measurement	**Short Description:** Conduct new construction acoustic trial measurements.	
Long Description	The assessment of surface ship acoustic signatures involves the measurement of radiated noise from surface ships within the Southeast Alaska Acoustic Measurement Facility's underway site. During the acoustic trial, the surface ship traverses the underway site in alternate directions, passing above the measurement arrays under a variety of operating conditions and speeds. Sensors on the arrays detect acoustic noise in the water and transmit it to shore facilities where the data is processed by computers. Scientists and engineers analyze the results, and the characteristics and the source of the noise emanating from the ship are determined. These operations typically run for 24 hours a day over the test period.	
Information Typical to the Event	**Platform:** Surface vessel **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 3–4 days	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projectors (e.g., HF3), mid-frequency projectors (e.g., MF9, MF10) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.2 Underwater Vessel Acoustic Measurement

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Underwater Vessel Acoustic Measurement	**Short Description:** Conduct acoustic trial measurements of underwater vessels.	
Long Description	Conduct new construction and post shakedown availability acoustic trial measurements. The primary purpose of the acoustic trial measurement is to identify any acoustic signals emanating from the vessel. The assessment of underwater acoustic signatures involves the measurement of radiated noise from underwater vessels (typically submarines) within the Southeast Alaska Acoustic Measurement Facility's underway and/or static site. During static tests, the submarine is positioned between two permanently moored barges and lowered on cables to the appropriate depth where acoustic measurements are taken during operation of various submarine systems. During the underway portion of the acoustic trial, the submarine traverses the site in alternate directions, passing between the measurement arrays under a variety of operating conditions, speeds, and depths. Sensors on the arrays detect acoustic noise in the water and transmit it to shore facilities where the data is processed by computers. Scientists and engineers analyze the results, and the characteristics and the source of the noise emanating from the submarine are determined. These operations typically run for 24 hours a day over the test period.	
Information Typical to the Event	**Platform:** Submarine **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 1–2 weeks	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency projectors (e.g., MF9, MF10), high-frequency projectors (e.g., HF3), low-frequency projectors (e.g., LF5) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.3 Underwater Vessel Hydrodynamic Performance Measurement

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Underwater Vessel Hydrodynamic Performance Measurement	**Short Description:** Conduct hydrodynamic performance trial measurements	
Long Description	The Southeast Alaska Acoustic Measurement Facility (SEAFAC) is used periodically to verify the accuracy of the navigational equipment used on subsurface vessels. The tracking features within SEAFAC's site are used to compare and calibrate on-vessel navigation systems. Typically, these operations occur once per year over a 2-day timeframe. In addition to calibration of navigation systems, the hydrodynamic performance of the submarine is tested and verified on the instrumented underway site.	
Information Typical to the Event	**Platform:** Submarine **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 2 days	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.4 Cold Water Training

Activity Name	Activity Description	
Miscellaneous Tests		
Cold Water Training	**Short Description:** Involves Navy personnel conducting insertion training in cold-water conditions. The training may include ingress and egress from subsurface vessels and small surface craft.	
Long Description	Fleet training for divers in a cold water environment and other diver training related to Navy divers supporting range operations. Acoustic systems may be used in diver training. The training may include ingress and egress from subsurface vessels positioned at the static site, and operations from small surface craft.	
Information Typical to the Event	**Platform:** Vessel, pierside, or shore **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** TBD	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projector (e.g., HF6), mid-frequency projector (e.g., MF9, MF10) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.5 Component System Testing

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Component System Testing	**Short Description:** Conduct testing on individual components of new defense acquisition systems	
Long Description	The Navy may develop or have developed new systems that require a measurement of the acoustic radiated signature. The Southeast Alaska Acoustic Measurement Facility will create tests such that the component system can be properly evaluated either at the underway site or the static site, dependent upon the requirements. Test varies depending on the specific system tested. Typical test involves acoustic measurement of system under operation. Duration of the testing is determined by the type of testing required and the complexity.	
Information Typical to the Event	**Platform:** Various **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 1–2 weeks	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projectors (e.g., HF6), mid-frequency projectors (e.g., MF9, MF10) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.6 Countermeasures Testing

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Countermeasures Testing	**Short Description:** Countermeasures emit active acoustic energy of varying frequencies into the water to mimic the acoustic characteristics of a target so that the actual threat or target remains undetected.	
Long Description	Countermeasures, which may take many different forms and represent a range of tactics, attempt to disrupt an attack intended for a target. Underwater, a countermeasure may emit sound that is louder than the target or in a different location that is similar to the target, causing the attacker to detour away from the target. Additionally, it could be something that looks like a threat or mimics the acoustic characteristics of a target, so that the actual threat or target remains undetected. By design, countermeasures emit active acoustic energy of varying frequencies into the water. The Southeast Alaska Acoustic Measurement Facility will deploy these countermeasures to measure and validate performance for engineering tests or acceptance testing.	
Information Typical to the Event	**Platform:** Various **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 3–4 days	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** None **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.7 Electromagnetic Measurement

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Electromagnetic Measurement	**Short Description:** Conduct new construction, post shakedown availability, and life cycle electromagnetic measurements.	
Long Description	Vessels require measurement to determine their electromagnetic characteristics on a regular basis. The measurements at the Southeast Alaska Acoustic Measurement Facility will provide this data to the Fleet.	
Information Typical to the Event	**Platform:** Various **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 1–2 weeks	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency projectors (e.g., MF9, MF10) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.8 Measurement System Repair and Replacement

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Measurement System Repair and Replacement	**Short Description:** Conduct repairs, replacements, and calibration of acoustic measurement systems.	
Long Description	The Southeast Alaska Acoustic Measurement Facility (SEAFAC) has many in-water assets that are used to make measurements and track vessels. Occasionally, these assets require repair or replacement. The SEAFAC crew will recover, repair, and then re-install the assets. This event occurs as needed and of varying duration based upon complexity and scope. Following the repairs, testing and validation of the equipment is needed to insure proper operation.	
Information Typical to the Event	**Platform:** Various **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 1–2 weeks	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Mid-frequency projectors (e.g., MF9, MF10) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.9 Project Operations

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Project Operations	**Short Description:** Support testing and training of fleet assets.	
Long Description	Prior to deployment overseas, every Navy ship conducts training and testing to prove they are ready for the deployment. The Southeast Alaska Acoustic Measurement Facility will be made available for this testing and training for submarines and possibly surface ships.	
Information Typical to the Event	**Platform:** Various **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 1–2 weeks	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projectors (e.g., HF6), mid-frequency projectors (e.g., MF9, MF10) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.4.1.10 Target Strength Trial

Activity Name	Activity Description	
Research, Development, Test, and Evaluation		
Target Strength Trial	**Short Description:** Asset moored to static site. Acoustic projectors and receive arrays will be rotated around asset. Broadband waveforms will be transmitted. Underwater tracking system will be utilized to monitor relative positions.	
Long Description	Submarines require measurement to determine their target strength if subjected to active sonar. This testing procedure allows the Southeast Alaska Acoustic Measurement Facility to measure the target strength of a submarine while moored in the static site. A source is deployed and moved around the submarine to make this measurement.	
Information Typical to the Event	**Platform:** Various **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** 3–4 days	**Location:** Western Behm Canal, Alaska
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** High-frequency projectors (e.g., HF6) **Energy:** None **Physical Disturbance and Strike:** Vessel strike **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.5 NAVAL SEA SYSTEMS COMMAND PROGRAM OFFICE SPONSORED TESTING ACTIVITIES

Naval Sea Systems Command also conducts tests that are sponsored by various program offices. Some of these activities are conducted in conjunction with fleet activities in the Offshore Area off the coast of Washington, Oregon, and northern California, and some occur in Puget Sound and at Navy piers at Naval Base (NAVBASE) Kitsap Bremerton, NAVBASE Kitsap Bangor, and Naval Station Everett. Tests within this category include, but are not limited to, anti-surface warfare, anti-submarine warfare, mine warfare, and force protection (maintaining security of Navy facilities, ships, submarines, and aircraft).

A.5.1 LIFE CYCLE ACTIVITIES

A.5.1.1 Pierside Sonar Testing

Activity Name	Activity Description	
Life Cycle Activities		
Pierside Sonar Testing	**Short Description:** Pierside testing of submarine and surface ship sonar systems occurs periodically following major maintenance periods and for routine maintenance.	
Long Description	Following major and routine maintenance periods and prior to deployment at-sea, pierside testing and maintenance of sonar systems is required. Multiple systems with active and passive acoustic sources such as tactical sonar, navigation systems, fathometers, underwater communications systems, underwater distress beacons, range finders, and other similar systems, would be tested.	
Information Typical to the Event	**Platform:** Submarines, surface ships **Systems:** Surface ship and submarine sonar, fathometers, pingers, underwater communication **Ordnance/Munitions:** None **Targets:** None **Duration:** Event duration for each test can be up to 3 weeks, with intermittent use of active sonar.	**Location:** Inland Waters: Naval Base (NAVBASE) Kitsap Bangor NAVBASE Kitsap Bremerton Naval Station Everett
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Sources such as submarine and surface ship sonar (e.g., ASW3, MF3, MF9, HF1, HF3), underwater communications (e.g., M3) **Energy:** None **Physical Disturbance and Strike Potential:** None **Entanglement Potential:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	Sonar would not be continuously active for the duration of the test	

A.5.2 SHIPBOARD PROTECTION SYSTEMS AND SWIMMER DEFENSE TESTING

A.5.2.1 Pierside Integrated Swimmer Defense

Activity Name	Activity Description	
Shipboard Protection Systems and Swimmer Defense Testing		
Pierside Integrated Swimmer Defense	**Short Description:** Swimmer defense testing ensures that systems can effectively detect, characterize, verify, and engage swimmer/diver threats in harbor environments.	
Long Description	Swimmer defense testing includes testing of systems to determine if they can effectively detect, characterize, verify, and engage swimmer/diver threats in harbor environments. Swimmer and diver threats are detected with high-frequency sonar. The threats are then warned to exit the water through the use of underwater voice communications. Under operational conditions, if the threat does not comply, non-lethal diver deterrent air guns are used against the threat; however, airguns would not be used under proposed testing conditions. Surface loudhailers are also used during the test. Event duration is 14 days, with intermittent periods of use for each system during this time.	
Information Typical to the Event	**Platform:** None **Systems:** High-frequency sonar; surface loudhailers **Ordnance/Munitions:** None **Targets:** None **Duration:** 14 days	**Location:** Inland Waters: Naval Base Kitsap Bangor
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Swimmer defense sonar (e.g., SD1, MF8, LF4) **Energy:** None **Physical Disturbance and Strike:** None **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	**Other Sensors:** Surface ship protection systems (e.g., communications systems, loudhailers, swimmer deterrents)	

A.5.3 UNMANNED VEHICLE TESTING

A.5.3.1 Unmanned Vehicle Development and Payload Testing

Activity Name	Activity Description	
Unmanned Vehicle Testing		
Unmanned Vehicle Development & Payload Testing	**Short Description:** Vehicle development involves the production and upgrade of new unmanned platforms on which to attach various payloads used for different purposes.	
Long Description	Vehicle development involves the production and upgrade of new unmanned underwater platforms on which to attach various payloads used for different purposes. Platforms can include unmanned underwater vehicles. Payload testing assesses various systems that can be incorporated onto unmanned platforms for mine warfare, bottom mapping, etc. Tests range from basic remote control and autonomous navigation tests to deployment and activation of onboard systems which may include hydrodynamic instruments, launchers, and recovery capabilities. These vehicles are capable of expanding the communication and surveillance capabilities of submarines, surface vessels, and terrestrial commands. Event duration for unmanned vehicles with traditional propulsion typically lasts up to 40 hours. Some propulsion systems (e.g., gliders) could operate continuously for multiple months.	
Information Typical to the Event	**Platform:** Support craft, pierside or shore **Systems:** Various **Ordnance/Munitions:** None **Targets:** None **Duration:** Tests may be from 10 minutes to 40 hours; some could operate for multiple days or months	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Unmanned vehicle sonar systems (e.g., MF9) **Energy:** None **Physical Disturbance and Strike:** In-water device strike, bottom crawling vehicles **Entanglement:** None **Ingestion:** None	
Detailed Military Expended Materials Information	None	
Assumptions Used for Analysis	None	

A.5.4 ANTI-SURFACE WARFARE/ANTI-SUBMARINE WARFARE TESTING

A.5.4.1 Torpedo (Explosive) Testing

Activity Name	Activity Description	
Anti-Surface Warfare (ASUW)/Anti-Submarine Warfare (ASW) Testing		
Torpedo (Explosive) Testing	**Short Description:** Air, surface, or submarine crews employ explosive torpedoes against artificial targets.	
Long Description	Non-explosive and explosive torpedoes (carrying a warhead) would be launched at a suspended target by a submarine and fixed- or rotary-winged aircraft or surface combatants. Torpedoes would detonate on an artificial target located at a depth between 200 and 700 feet below the water's surface. Event duration is 1–2 days during daylight hours. Only 1 heavyweight torpedo test could occur in 1 day; 2 heavyweight torpedo tests could occur on consecutive days. Two lightweight torpedo tests could occur in a single day.	
Information Typical to the Event	**Platform:** Submarine; surface ship; fixed- and rotary–wing aircraft **Systems:** None **Ordnance/Munitions:** Torpedoes (heavyweight and lightweight) – high-explosive (HE) and non-explosive practice munitions (NEPM) **Targets:** Stationary Artificial Targets (e.g., MK 28) **Duration:** 1–2 days during daylight hours	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Underwater explosion (e.g., E8, E11), torpedo sonar (e.g., TORP1, TORP2) **Energy:** None **Physical Disturbance and Strike:** Vessel strike, In-water device strike **Entanglement:** decelerator/parachutes (sonobuoy and torpedo), guidance wire **Ingestion:** target and torpedo fragments, decelerator/parachutes (sonobuoy and torpedo), torpedo launch accessories	

Detailed Military Expended Materials Information	• 4 HE torpedoes and associated launch accessories/event
	• 6 non-explosive torpedo accessories/event
	• Torpedo launch accessories
	  o Lightweight torpedo accessories (dependent upon launch platform/delivery):
	  ▪ Air-launched: nose cap, suspension bands, air stabilizer, sway brace pad, arming wire, fahnstock clip
	  ▪ High Altitude ASW Weapons Capability: all of above plus wing kit
	  ▪ Vertical launch accessories: air-launched accessories plus rocket booster, airframe, parachute
	  ▪ MK 46 exercise torpedo will drop two lead weights
	• Heavyweight torpedo accessories: guidance wire, flex hose	

Assumptions Used for Analysis	One guidance wire and one flex hose for each heavyweight torpedo fired (HE or NEPM). Two fahnstock clips, one of each other item per air-launched torpedo (HE or NEPM). Lead weights are associated with the NEPM MK 46 torpedo only.	

A.5.4.2 Torpedo (Non-Explosive) Testing

Activity Name	Activity Description	
Anti-Surface Warfare (ASUW)/Anti-Submarine Warfare (ASW) Testing		
Torpedo (Non-explosive) Testing	**Short Description:** Air, surface, or submarine crews employ non-explosive torpedoes against submarines or surface vessels.	
Long Description	Aerial, surface, and subsurface assets fire exercise torpedoes against surface or subsurface targets. Torpedo testing evaluates the performance and the effectiveness of hardware and software upgrades of heavyweight and/or lightweight torpedoes. Event duration is dependent on number of torpedoes fired. Events can last up to 2 weeks. Typically, no more than 8 torpedoes are fired per day during daylight hours.	
Information Typical to the Event	**Platform:** Submarines, surface ships, fixed- and rotary–wing aircraft **Systems:** Surface ship and submarine sonar, sonobuoys, dipping sonar **Ordnance/Munitions:** Lightweight torpedoes, heavyweight torpedoes **Targets:** Submarines, surface ships, Motorized Autonomous Targets (e.g., Expendable Mobile Anti-Submarine Warfare Training Target), Stationary Artificial Targets (e.g., Fleet Training Target) **Duration:** Up to 2 weeks	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Submarine and surface ship sonar (e.g., ASW3, MF10), active sonobuoys (e.g., MF5), torpedo sonar (e.g., TORP1, TORP2), acoustic decoys (e.g., ASW4) **Energy:** None **Physical Disturbance and Strike:** non-explosive practice munition strike **Entanglement:** decelerator/parachutes (sonobuoy and torpedo), guidance wire **Ingestion:** decelerator/parachutes (sonobuoy and torpedo), torpedo launch accessories	

Detailed Military Expended Material Information	• Sonobuoys
	• Expendable targets
	• Acoustic countermeasures
	• Torpedo launch accessories
	  o Lightweight torpedo accessories (dependent upon launch platform/delivery):
	  ▪ Air-launched: nose cap, suspension bands, air stabilizer, sway brace pad, arming wire, fahnstock clip
	  ▪ High Altitude ASW Weapons Capability: all of above plus wing kit
	  ▪ Vertical launch accessories: air-launched accessories plus rocket booster, airframe, parachute
	  ▪ MK 46 torpedo will drop two lead weights
	  o Heavyweight torpedo accessories: guidance wire, flex hose	

Assumptions Used for Analysis	All torpedoes are recovered One guidance wire and one flex hose for each heavyweight torpedo fired. Two fahnstock clips, one of each other item per air-launched torpedo.	

A.5.4.3 Countermeasure Testing

Activity Name	Activity Description	
Anti-Surface Warfare (ASUW)/Anti-Submarine Warfare (ASW) Testing		
Countermeasure Testing	**Short Description:** Countermeasure testing involves the testing of systems that would detect, localize, track, and attack incoming weapons.	
Long Description	Countermeasure testing involves the testing of systems that would detect, localize, track, and sometimes attack incoming weapons. Countermeasure defense systems testing involves the launch of non-explosive torpedoes at incoming weapons. Acoustic systems testing includes towed arrays. Event duration is up to 10 days with a maximum of 40 anti-torpedo torpedoes fired (up to 10 shots occurring per day), whereas towed array countermeasure tests can be as short as 4 hours.	
Information Typical to the Event	**Platform:** Surface ships **Systems:** Anti-torpedo torpedo defense systems, towed arrays (e.g., NIXIE) **Ordnance/Munitions:** Lightweight torpedoes (non-explosive practice munitions [NEPM]) **Targets:** Torpedo emulators **Duration:** 4 hours–10 days	**Location:** Offshore Area Inland Waters
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Surface ship sonar (e.g., ASW3), high-frequency sources (e.g., HF5), torpedo sonar (e.g., TORP1) **Energy:** None **Physical Disturbance and Strike:** NEPM strike **Entanglement:** None **Ingestion:** Torpedo launch accessories	
Detailed Military Expended Material Information	Torpedo launch accessories	
Assumptions Used for Analysis	None	

A.5.5 NEW SHIP CONSTRUCTION

A.5.5.1 Anti-Submarine Warfare Mission Package Testing

Activity Name	Activity Description	
New Ship Construction		
Anti-Submarine Warfare (ASW) Mission Package Testing	**Short Description:** Ships and their supporting platforms (e.g., helicopters, unmanned aerial vehicles) detect, localize, and prosecute submarines.	
Long Description	Littoral combat ships conduct detect-to-engage operations against modern diesel-electric and nuclear submarines using airborne and surface assets (both manned and unmanned). Active and passive acoustic systems are used to detect and track submarine targets, culminating in the deployment of lightweight torpedoes to engage the threat.	
Information Typical to the Event	**Platform:** Littoral Combat Ship; rotary wing aircraft **Systems:** Surface ship sonar, helicopter-deployed sonar, active sonobuoys, torpedo sonar **Ordnance/Munitions:** Non-explosive torpedoes **Targets:** None **Duration:** Event duration is approximately 1–2 weeks, with 4–8 hours of active sonar use with intervals of non-activity in between.	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Surface ship sonar (e.g., ASW1, ASW3, MF12), helicopter-deployed sonar (e.g., MF4), active sonobuoys (e.g., MF5), torpedo sonar (e.g., TORP1) **Energy:** None **Physical Disturbance and Strike:** Vessel strike; towed device strike **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes	
Detailed Military Expended Material Information	Torpedo launch accessories, sonobuoys	
Assumptions Used for Analysis	None	

A.6 NAVAL AIR SYSTEMS COMMAND TESTING ACTIVITIES

Naval Air Systems Command testing events generally fall into the primary mission areas used by the Fleet and, in terms of their potential environmental effects, Naval Air Systems Command testing events are very similar to Fleet training events.

Platforms and systems tested by the Naval Air Systems Command are eventually transferred to the Fleet and used in Fleet training events. Those systems and platforms that are transferred to the Fleet within the timeframe of this document are analyzed in the training sections of this EIS/OEIS. The results of the analysis of platforms and systems used in training events may differ when the same platforms or systems are used during testing events because, for example, the location of the event may be different or the event may be conducted in a different manner. The following activity descriptions are specific to Naval Air Systems Command testing events.

A.6.1 ANTI-SUBMARINE WARFARE

A.6.1.1 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Directional Command Activated Sonobuoy System

Activity Name	Activity Description	
Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Directional Command Activated Sonobuoy System [DICASS])	**Short Description:** This test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	
Long Description	Similar to Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft, an Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications and meet operational requirements. For this test event, P-3 or P-8A fixed-wing aircraft conduct anti-submarine warfare using passive and active sonobuoys (e.g., AN/SSQ-62 DICASS). This activity would be conducted in deep (typically beyond 100 ft.) waters and weapons testing could be initiated from a land base or surface ship. Some Anti-Submarine Warfare Maritime Patrol Aircraft Tracking Test – DICASS events could be conducted as part of a Coordinated Event with fleet training activities.	
Information Typical to the Event	**Platform:** Surface combatant, submarine, fixed wing aircraft **Systems:** Sonobuoys (AN/SSQ-62x DICASS and passive sonobuoys) **Ordnance/Munitions:** None **Targets:** None **Duration:** 6 flight hours/event	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Sonar, sonobuoys (e.g., MF5), aircraft noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike, aircraft strike (seabirds only) **Entanglement:** Parachutes/decelerators **Ingestion:** Decelerator/parachutes	
Detailed Military Expended Materials Information	Sonobuoys, to include decelerator/parachutes, lead seawater batteries, lithium batteries (being phased out)	
Assumptions Used for Analysis	Assume one decelerator/parachute per sonobuoy	

A.6.1.2 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Multistatic Active Coherent Sonobuoy System

Activity Name	Activity Description	
Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Multistatic Active Coherent [MAC])	**Short Description:** This test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	
Long Description	Similar to Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft, an Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications and meet operational requirements. For this test event, P-3 or P-8A fixed-wing aircraft conduct anti-submarine warfare using passive and active sonobuoys (e.g., AN/SSQ-125 MAC). This activity would be conducted in deep (typically beyond 100 feet) waters and weapons testing could be initiated from a land base or surface ship. Some Anti-Submarine Warfare Maritime Patrol Aircraft Tracking Test MAC events could be conducted as part of a Coordinated Event with fleet training activities.	
Information Typical to the Event	**Platform:** Surface combatant, submarine, fixed wing aircraft, rotary wing aircraft **Systems:** Sonobuoys (AN/SSQ-125 MAC and passive sonobuoys) **Ordnance/Munitions:** None **Targets:** None **Duration:** 6 flight hours/event	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Sonar, sonobuoys (e.g., ASW2), aircraft noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike, aircraft strike (seabirds only) **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes	
Detailed Military Expended Materials Information	Sonobuoys, to include decelerator/parachutes, lead seawater batteries, lithium batteries (being phased out)	
Assumptions Used for Analysis	Assume one decelerator/parachute per sonobuoy	

A.6.1.3 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Signal, Underwater Sound Sonobuoys

Activity Name	Activity Description	
Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Signal, Underwater Sound [SUS])	**Short Description:** This test evaluates the sensors and systems used by maritime patrol aircraft to communicate with submarines using any of the family of SUS systems.	
Long Description	Similar to Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft, an Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications and meet operational requirements. For this test event, P-3 or P-8A fixed-wing aircraft conduct anti-submarine warfare using passive and active sonobuoys (i.e., MK-84 SUS) and explosive sonobuoys (i.e., MK-61 SUS, MK-64 SUS, and MK-82 SUS). This activity would be conducted in deep (typically beyond 100 feet) waters and weapons testing could be initiated from a land base or surface ship. Some Anti-Submarine Warfare Maritime Patrol Aircraft Tracking Test – SUS Sonobuoy events could be conducted as part of a Coordinated Event with fleet training activities.	
Information Typical to the Event	**Platform:** Surface combatant, submarine, fixed wing aircraft, rotary wing aircraft **Systems:** Sonobuoys (MK-61 SUS, MK-64 SUS, MK-82 SUS, MK-84 SUS, and passive sonobuoys) **Ordnance/Munitions:** High explosive sonobuoy systems described above **Targets:** None **Duration:** 6 flight hours/event	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Sonar, sonobuoys (e.g., MF6), underwater explosions (e.g., E3), aircraft noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike, aircraft strike (seabirds only) **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes, sonobuoy fragments	
Detailed Military Expended Materials Information	Sonobuoys, to include decelerator/parachutes, lead seawater batteries, lithium batteries (being phased out)	
Assumptions Used for Analysis	Assume one decelerator/parachute per sonobuoy	

A.6.1.4 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – Improved Extended Echo Ranging Sonobuoy System

Activity Name	Activity Description	
Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Improved Extended Echo Ranging [IEER])	**Short Description:** The test evaluations the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	
Long Description	Similar to Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft, an Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications and meet operational requirements. For this test event, P-3 or P-8A fixed-wing aircraft conduct anti-submarine warfare using passive and explosive sonobuoys (i.e., AN/SSQ-110 IEER). This activity would be conducted in deep (typically beyond 100 feet) waters and weapons testing could be initiated from a land base or surface ship. Some Anti-Submarine Warfare Maritime Patrol Aircraft Tracking Test – IEER Sonobuoy events could be conducted as part of a Coordinated Event with fleet training activities.	
Information Typical to the Event	**Platform:** Surface combatant, submarine, fixed wing aircraft, rotary wing aircraft **Systems:** Sonobuoys (AN/SSQ-110x IEER and passive sonobuoys) **Ordnance/Munitions:** High explosive sonobuoy systems described above **Targets:** None **Duration:** 6 flight hours/event	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Underwater explosions (e.g., E4), aircraft noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike, aircraft strike (seabirds only) **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes, sonobuoy fragments	
Detailed Military Expended Materials Information	Sonobuoys, to include decelerator/parachutes, lead seawater batteries, lithium batteries (being phased out)	
Assumptions Used for Analysis	Assume one decelerator/parachute per sonobuoy	

A.6.1.5 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft – High Duty Cycle Sonobuoy System

Activity Name	Activity Description	
Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (High Duty Cycle [HDC])	**Short Description:** The test evaluations the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	
Long Description	Similar to Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft, an Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications and meet operational requirements. For this test event, P-3 or P-8A fixed-wing aircraft conduct anti-submarine warfare using passive and active sonobuoys (i.e., HDC sonar). This activity would be conducted in deep (typically beyond 100 feet) waters and weapons testing could be initiated from a land base or surface ship. Some Anti-Submarine Warfare Maritime Patrol Aircraft Tracking Test – HDC Sonobuoy events could be conducted as part of a Coordinated Event with fleet training activities.	
Information Typical to the Event	**Platform:** Surface combatant, submarine, fixed wing aircraft, rotary wing aircraft **Systems:** Sonobuoys – HDC active and passive sonobuoys **Ordnance/Munitions:** None **Targets:** None **Duration:** 6 flight hours/event	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Sonar, sonobuoys (e.g., ASW2), aircraft noise **Energy:** None **Physical Disturbance and Strike:** Military expended materials strike, aircraft strike (seabirds only) **Entanglement:** Decelerator/parachutes **Ingestion:** Decelerator/parachutes	
Detailed Military Expended Materials Information	Sonobuoys, to include decelerator/parachutes, lead seawater batteries, lithium batteries (being phased out)	
Assumptions Used for Analysis	Assume one decelerator/parachute per sonobuoy	

A.6.2 ELECTRONIC WARFARE

A.6.2.1 Flare Test

Activity Name	Activity Description	
Electronic Warfare (EW)		
Flare Test	**Short Description:** Flare tests evaluate newly developed or enhanced flares, flare dispensing equipment, or modified aircraft systems against flare deployment. Tests may also train pilots and aircrew in the use of newly developed or modified flare deployment systems. Flare tests are often conducted with other test events, and are not typically conducted as standalone tests.	
Long Description	Flare tests are conducted to evaluate new flares, newly developed or modified flare deployment systems; to ensure that other newly enhanced aircraft systems are compatible with flare deployment; and to train pilots and aircrew in the use of newly developed or modified flare deployment systems. Flare tests are often conducted with other test events, and are not typically conducted as stand-alone tests. During a flare test, flares (and in some cases chaff) are deployed, but no weapons are typically fired. Fixed-wing aircraft deploy flares as a defensive tactic to disrupt the infrared missile guidance systems used by heat-seeking missiles, thereby causing the missile to lock onto the flare instead of onto the aircraft and enabling the aircraft to avoid the threat. In a typical scenario, an aircraft may detect the electronic targeting signals emitted from threat radars or missiles, or aircrew may visually identify a threat missile plume when a missile is launched. At a strategically appropriate time, the pilot dispenses flares and immediately maneuvers the aircraft to distract and defeat the threat. During a typical flare test, an aircraft will dispense flares 3,000 feet above mean sea level, and flares are completely consumed while in the air. Aircraft flares use a magnesium extruded flare grain. Flare types commonly deployed during Naval Air Systems Command testing activities include but are not limited to: MJU-57, MJU-49, and MJU-38 for high-speed aircraft and MJU-32 for low-speed aircraft.	
Information Typical to the Event	**Platform:** Fixed-wing aircraft **Systems:** Flares: MJU-57, MJU-49, and MJU-38 for high speed aircraft and MJU-32; Joint Allied Threat Assessment System/Common Infrared Countermeasures **Ordnance/Munitions:** None **Targets:** None **Duration:** 2–4 flight hours/event	**Location:** Offshore Area
Potential Impact Concerns *(Information regarding deconstruct categories and stressors)*	**Acoustic:** Aircraft noise **Energy:** None **Physical Disturbance and Strike:** Aircraft strike (birds only) **Entanglement:** None **Ingestion:** End caps	
Detailed Military Expended Materials Information	Flares (end caps and pistons), chaff	
Assumptions Used for Analysis	Flare use from all other events are captured under this activity. Estimated 60 flares and 60 chaff cartridges per event	

Appendix B: Notice of Intent

institutions, and human rights communities.

Board members appointed by the Secretary of Defense, who are not full-time or permanent part-time federal employees, shall be appointed to serve as experts and consultants under the authority of 5 U.S.C. 3109 and shall serve as special government employee members. With the exception of travel and per diem for official Board related travel, Board members shall serve without compensation.

The Secretary of Defense may approve the appointment of Board members for one to four year terms of service; however, no member, unless authorized by the Secretary of Defense, may serve more than two consecutive terms of service. This same term of service limitation also applies to any DoD authorized subcommittees.

Whenever possible, appointments shall be staggered to avoid complete turnover of the Board's membership at one time. In addition, the Board may be assisted by non-voting subject matter experts or consultants. These consultants are designated at the request of the Board by the Secretary of the Army with the concurrence of the Secretary of Defense.

Each Board member is appointed to provide advice on behalf of the government on the basis of his or her best judgment without representing any particular point of view and in a manner that is free from conflict of interest.

The Department, when necessary, and consistent with the Board's mission and DoD policies and procedures may establish subcommittees deemed necessary to support the Board. Establishment of subcommittees will be based upon a written determination, to include terms of reference, by the Secretary of Defense, the Deputy Secretary of Defense or the advisory committee's sponsor. Such subcommittees shall not work independently of the chartered Board, and shall report all their recommendations and advice to the Board for full deliberation and discussion. Subcommittees have no authority to make decisions on behalf of the chartered Board; nor can any subcommittee or its members update or report directly to the Department of Defense or any Federal officers or employees.

All subcommittee members shall be appointed in the same manner as the Board members; that is, the Secretary of Defense shall appoint subcommittee members even if the member in question is already a Board member. Subcommittee members, with the approval of the Secretary of Defense, may serve a term of service on the subcommittee of one to four years; however, no member shall serve more than two consecutive terms of service on the subcommittee.

Subcommittee members, if not full-time or part-time government employees, shall be appointed to serve as experts and consultants under the authority of 5 U.S.C. 3109, and shall serve as special government employees, whose appointments must be renewed by the Secretary of Defense on an annual basis. With the exception of travel and per diem for official Board related travel, subcommittee members shall serve without compensation.

All subcommittees operate under the provisions of FACA, the Government in the Sunshine Act of 1976 (5 U.S.C. 552b), governing Federal statutes and regulations, and governing DoD policies/procedures.

FOR FURTHER INFORMATION CONTACT: Jim Freeman, Deputy Advisory Committee Management Officer for the Department of Defense, 703–692–5952.

SUPPLEMENTARY INFORMATION: The Board shall meet at the call of the Board's Designated Federal Officer, in consultation with the Board's Chairperson. The estimated number of Board meetings is one per year.

In addition, the Designated Federal Officer is required to be in attendance at all Board and subcommittee meetings for the entire duration of each and every meeting; however, in the absence of the Designated Federal Officer, the Alternate Designated Federal Officer shall attend the entire duration of the Board or subcommittee meeting.

Pursuant to 41 CFR 102–3.105(j) and 102–3.140, the public or interested organizations may submit written statements to Board of Visitors for the Western Hemisphere Institute for Security Cooperation membership about the Board's mission and functions. Written statements may be submitted at any time or in response to the stated agenda of planned meeting of Board of Visitors for the Western Hemisphere Institute for Security Cooperation.

All written statements shall be submitted to the Designated Federal Officer for the Board of Visitors for the Western Hemisphere Institute for Security Cooperation, and this individual will ensure that the written statements are provided to the membership for their consideration. Contact information for the Board of Visitors for the Western Hemisphere Institute for Security Cooperation Designated Federal Officer can be obtained from the GSA's FACA Database—*https://www.fido.gov/facadatabase/public.asp.*

The Designated Federal Officer, pursuant to 41 CFR 102–3.150, will announce planned meetings of the Board of Visitors for the Western Hemisphere Institute for Security Cooperation. The Designated Federal Officer, at that time, may provide additional guidance on the submission of written statements that are in response to the stated agenda for the planned meeting in question.

Dated: February 22, 2012.

Aaron Siegel,

Alternate OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 2012–4440 Filed 2–24–12; 8:45 am]

BILLING CODE 5001–06–P

DEPARTMENT OF DEFENSE

Department of the Navy

Notice of Intent To Prepare an Environmental Impact Statement/ Overseas Environmental Impact Statement for Military Readiness Activities in the Northwest Training and Testing Study Area and To Announce Public Scoping Meetings

AGENCY: Department of the Navy, DoD.

ACTION: Notice.

SUMMARY: Pursuant to section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969, as implemented by the Council on Environmental Quality Regulations (40 Code of Federal Regulations Parts 1500–1508), and Executive Order 12114, the Department of the Navy (DoN) announces its intent to prepare an Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to assess the potential environmental impacts associated with training and testing military readiness activities conducted in the Northwest Training and Testing (NWTT) Study Area (Study Area). The Study Area is composed of established maritime operating and warning areas in the eastern north Pacific Ocean region, located adjacent to the Northwest coast of the United States, to include the Strait of Juan de Fuca, Puget Sound, and the Behm canal in southeastern Alaska. The Study Area includes four existing range complexes and facilities: The Northwest Training Range Complex (NWTRC), the Naval Undersea Warfare Center (NUWC) Keyport Range Complex, Carr Inlet Operations Area, and the Southeast Alaska Acoustic Measurement Facility (SEAFAC). In addition to these range complexes, the Study Area also includes

pierside locations on Navy bases where sonar maintenance and testing occurs within the Study Area, and inland waters that are not part of the range complexes, where training and testing may occur.

The DoN is preparing this EIS/OEIS to renew current federal regulatory permits and authorizations, address proposed, future training and testing activities not covered under existing permits and authorizations (such as those activities proposed to be conducted in the Carr Inlet Operations Area), and include new platforms and weapons systems training and testing requirements.

The DoN will invite the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to be cooperating agencies in preparation of this EIS and OEIS pursuant to 40 CFR 1501.6.

DATES AND ADDRESSES: Nine public scoping meetings will be held between 5 p.m. and 8 p.m. on:

- Tuesday, March 13, 2012.
  Oak Harbor School District Office, Administrative Services Center Board Room, 350 S. Oak Harbor Street, Oak Harbor, Washington 98277.
- Wednesday, March 14, 2012.
  Quilcene School District Multipurpose Room, 294715 U.S. Highway 101, Quilcene, Washington, 98376.
- Thursday, March 15, 2012.
  Central Kitsap High School Cafeteria, 3700 NW Anderson Hill Road, Silverdale, Washington 98383.
- Friday, March 16, 2012.
  Grays Harbor College HUB, 1620 Edward P. Smith Drive, Aberdeen, Washington 98520.
- Monday, March 19, 2012.
  Tillamook County Fairgrounds Auditorium, 4603 East 3rd Street, Tillamook, Oregon 97141.
- Tuesday, March 20, 2012.
  Hatfield Marine Science Center, 2030 SE Marine Science Drive, Newport, Oregon 97365.
- Thursday, March 22, 2012.
  Eureka Wharfinger Building, 1 Marina Way, Eureka, California 95501.
- Friday, March 23, 2012.
  Fort Bragg Town Hall, 363 North Main Street, Fort Bragg, California 95437.
- Tuesday, March 27, 2012.
  Ted Ferry Civic Center, 888 Venetia Way, Ketchikan, Alaska 99901.

Each of the nine scoping meetings will consist of an informal, open house session with information stations staffed by DoN representatives. Comments will be accepted from the public at all scoping meetings. Meeting details will be announced in local newspapers. Additional information concerning meeting times will be available on the EIS/OEIS web page located at: *http://www.NWTTEIS.com.*

FOR FURTHER INFORMATION CONTACT: Ms. Kimberly Kler, Naval Facilities Engineering Command, Northwest. Attention: NWTT EIS/OEIS, 1101 Tautog Circle, Suite 203, Silverdale, Washington 98315–1101.

SUPPLEMENTARY INFORMATION: The DoN's Proposed Action is to conduct training and testing activities, primarily within existing range complexes, operating areas, testing ranges, and select Navy pierside locations located in the Northwest.

The Study Area combines the at-sea portions (air and sea space) of the following range complexes that were previously analyzed under NEPA: The NWTRC and the NUWC Keyport Range Complex. The Study Area also includes Navy piers within Puget Sound where sonar maintenance and testing occurs, Carr Inlet Operations Area, and SEAFAC.

The air and sea space component of the NWTRC includes the area off the coast of Washington, Oregon, and northern California—out to approximately 250 nautical miles, specific training areas within the Strait of Juan de Fuca and Puget Sound, and the Olympic Military Operations Areas.

The NUWC Range Complex is composed of three geographically distinct range sites; two within Puget Sound and one in the Pacific Ocean. The Keyport Range Site is located in Kitsap County and includes portions of Liberty Bay and Port Orchard Reach (also known as Port Orchard Narrows). The Dabob Bay Range Complex Site is located in Hood Canal and Dabob Bay, in Jefferson, Mason, and Kitsap counties. The Quinault Underwater Tracking Range Site is located in the Pacific Ocean off the coast of Jefferson and Grays Harbor Counties in Washington.

The Carr Inlet Operations Area is located in southern Puget Sound, in an arm of water between Key Peninsula and Gig Harbor Peninsula.

The Southeast Alaska Acoustic Measurement Facility (SEAFAC) is located in the Western Behm Canal in Ketchikan Gateway Borough, Alaska.

The proposed action is to conduct military training and testing activities in the Study Area. The purpose of the Proposed Action is to achieve and maintain military readiness to meet the requirements of Title 10 of the U.S. Code, thereby ensuring the DoN meets its mission to maintain, train and equip combat-ready military forces capable of winning wars, deterring aggression, and maintaining freedom of the seas.

The alternatives analyzed in the NWTT EIS/OEIS are as follows.

(1) No Action Alternative: Baseline training and testing activities, as defined by existing DoN environmental planning documents, including the NWTRC EIS/OEIS and the NUWC Keyport Range Complex Extension EIS/OEIS.

(2) Alternative 1: The alternative consists of the No Action alternative, plus the all-inclusive Study Area, and adjustments to types and levels of activities, from the baseline as necessary to support current and planned DoN training and testing requirements. This Alternative considers:

- activities conducted throughout the Study Area, including testing activities at the Carr Inlet Operations Area and SEAFAC.
- mission requirements associated with force structure changes, including those resulting from the development, testing, and ultimate introduction of new platforms (ships and aircraft), and weapons systems into the fleet.

(3) Alternative 2: Consists of Alternative 1 plus, an increase in the tempo of training and testing activities.

Resource areas that will be addressed because of the potential effects from the Proposed Action include, but are not limited to, ocean and biological resources (including marine mammals and threatened and endangered species), terrestrial resources (including threatened and endangered species), sediments and water quality, air quality, airborne soundscape, cultural resources, transportation, regional economy, recreation, and public health and safety.

The scoping process will be used to identify community concerns and local issues that will be addressed in the EIS/OEIS. Federal agencies, Native American Indian Tribes and Nations, state agencies, local agencies, the public, and interested persons are encouraged to provide comments to the DoN to identify specific issues or topics of environmental concern that the commenter believes the DoN should consider.

All comments, provided orally or in writing at the scoping meetings, will receive the same consideration during EIS/OEIS preparation. Written comments must be postmarked no later than April 16, 2012, and should be mailed to: Ms. Kimberly Kler, Naval Facilities Engineering Command, Northwest, 1101 Tautog Circle, Suite 203, Silverdale, Washington 98315–1101, Attention: NWTT EIS/OEIS Project Manager.

Dated: February 22, 2012.

J.M. Beal,

Office of the Judge Advocate General, U.S. Navy, Federal Register Liaison Officer.

[FR Doc. 2012–4458 Filed 2–24–12; 8:45 am]

BILLING CODE 3810–FF–P

DEPARTMENT OF EDUCATION

Notice of Submission for OMB Review

AGENCY: Department of Education.

ACTION: Comment request.

SUMMARY: The Director, Information Collection Clearance Division, Privacy, Information and Records Management Services, Office of Management, invites comments on the submission for OMB review as required by the Paperwork Reduction Act of 1995 (Pub. L. 104–13).

DATES: Interested persons are invited to submit comments on or before March 28, 2012.

ADDRESSES: Written comments should be addressed to the Office of Information and Regulatory Affairs, Attention: Education Desk Officer, Office of Management and Budget, 725 17th Street NW., Room 10222, New Executive Office Building, Washington, DC 20503, be faxed to (202) 395–5806 or emailed to *oira_submission@omb.eop.gov* with a cc: to *ICDocketMgr@ed.gov*. Please note that written comments received in response to this notice will be considered public records.

SUPPLEMENTARY INFORMATION: Section 3506 of the Paperwork Reduction Act of 1995 (44 U.S.C. chapter 35) requires that the Office of Management and Budget (OMB) provide interested Federal agencies and the public an early opportunity to comment on information collection requests. The OMB is particularly interested in comments which: (1) Evaluate whether the proposed collection of information is necessary for the proper performance of the functions of the agency, including whether the information will have practical utility; (2) Evaluate the accuracy of the agency's estimate of the burden of the proposed collection of information, including the validity of the methodology and assumptions used; (3) Enhance the quality, utility, and clarity of the information to be collected; and (4) Minimize the burden of the collection of information on those who are to respond, including through the use of appropriate automated, electronic, mechanical, or other technological collection techniques or other forms of information technology.

Dated: February 21, 2012.

Darrin A. King,

Director, Information Collection Clearance Division, Privacy, Information and Records Management Services, Office of Management.

Institute of Education Sciences

Type of Review: New.

Title of Collection: Impact Evaluation of Teacher and Leader Evaluation Systems.

OMB Control Number: Pending.

Affected Public: State, Local, or Tribal Government.

Total Estimated Number of Annual Responses: 59.

Total Estimated Annual Burden Hours: 891.

Abstract: This information collection package requests clearance to recruit districts for a study of a performance evaluation system for principals and teachers. The study will provide important implementation and impact information on the kinds of performance evaluation systems currently discussed in federal policy. Study findings will be presented in two reports, one scheduled for release in late 2014 and the other in late 2015.

Copies of the information collection submission for OMB review may be accessed from the RegInfo.gov Web site at *http://www.reginfo.gov/public/do/PRAMain* or from the Department's Web site at *http://edicsweb.ed.gov*, by selecting the "Browse Pending Collections" link and by clicking on link number 04758. When you access the information collection, click on "Download Attachments" to view. Written requests for information should be addressed to U.S. Department of Education, 400 Maryland Avenue SW, LBJ, Washington, DC 20202–4537. Requests may also be electronically mailed to the Internet address *ICDocketMgr@ed.gov* or faxed to 202–401–0920. Please specify the complete title of the information collection and OMB Control Number when making your request.

Individuals who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 1–800–877–8339.

[FR Doc. 2012–4375 Filed 2–24–12; 8:45 am]

BILLING CODE 4000–01–P

DEPARTMENT OF EDUCATION

Applications for New Awards; Technology and Media Services for Individuals With Disabilities—Educational Materials in Accessible Formats for Students With Visual Impairments and Other Print Disabilities

AGENCY: Office of Special Education and Rehabilitative Services, Department of Education.

ACTION: Notice.

Overview Information

Technology and Media Services for Individuals With Disabilities—Educational Materials in Accessible Formats for Students With Visual Impairments and Other Print Disabilities

Notice inviting applications for new awards for fiscal year (FY) 2012.

Catalog of Federal Domestic Assistance (CFDA) Number: 84.327D.

DATES:

Applications Available: February 27, 2012.

Deadline for Transmittal of Applications: April 12, 2012.

Deadline for Intergovernmental Review: June 11, 2012.

Full Text of Announcement

I. Funding Opportunity Description

Purpose of Program: The purpose of the Technology and Media Services for Individuals with Disabilities program is to: (1) Improve results for students with disabilities by promoting the development, demonstration, and use of technology; (2) support educational media services activities designed to be of educational value in the classroom for students with disabilities; and (3) provide support for captioning and video description that is appropriate for use in the classroom.

Priority: In accordance with 34 CFR 75.105(b)(2)(v), this priority is from allowable activities specified in the statute (see sections 674(c)(1)(D) and 681(d) of the Individuals with Disabilities Education Act (IDEA) (20 U.S.C. 1474(c)(1)(D) and 1481(D)).

Absolute Priority: For FY 2012, this priority is an absolute priority. Under 34 CFR 75.105(c)(3), we consider only applications that meet this priority.

This priority is:

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Appendix C: Agency Correspondence

TABLE OF CONTENTS

COOPERATING AGENCY CORRESPONDENCE C-1

NAVY REQUEST FOR NATIONAL MARINE FISHERIES SERVICE TO SERVE AS A COOPERATING AGENCY C-1

NATIONAL MARINE FISHERIES RESPONSE C-6

NAVY REQUEST FOR U.S. FISH AND WILDLIFE SERVICE TO SERVE AS A COOPERATING AGENCY C-7

NAVY REQUEST FOR U.S. COAST GUARD TO SERVE AS A COOPERATING AGENCY C-12

U.S. COAST GUARD ACCEPTANCE TO SERVE AS A COOPERATING AGENCY C-15

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DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350-2000

IN REPLY REFER TO

5090
N454/12U158071
16 February 2012

Mr. Eric C. Schwaab
Assistant Administrator
National Marine Fisheries Service
1315 East West Highway
Silver Springs, MD 20910

Dear Mr. Schwaab:

In accordance with the National Environmental Policy Act (NEPA), the United States (U.S.) Department of the Navy (Navy) is initiating the preparation of an Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to assess the potential environmental impacts associated with two categories of Navy readiness activities: training and testing that include the use of active sonar and explosives in the Northwest Training and Testing (NWTT) Study Area. The NWTT Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, located adjacent to the northwest coast of the United States, and areas within the Strait of Juan de Fuca, Puget Sound, and the Behm Canal in southeastern Alaska. The NWTT Study Area (Study Area) includes four existing range complexes and facilities: the Northwest Training Range Complex, the Naval Undersea Warfare Center (NUWC) Keyport Range Complex, Carr Inlet Operations Area, and the Southeast Alaska Acoustic Measurement Facility (SEAFAC). In addition to these range complexes, the Study Area also includes select Navy pierside locations and inland waters that are not part of the range complexes where training and sonar testing may occur.

An important aspect of the NWTT EIS/OEIS will be the analysis of the acoustic effects to marine species protected under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). The NWTT EIS/OEIS is also intended to serve as a basis for the renewal of current regulatory permits and authorizations, address current training and testing not covered under the existing permits and authorizations, and obtain those permits and authorizations necessary to support force structure changes and emerging and future training and testing requirements. The MMPA Final Rule and ESA Section 7 Programmatic Biological Opinion for NWTRC will expire in October 2015 and June 2015, respectively. The NUWC Keyport Range Complex MMPA Final Rule and ESA Section 7 Programmatic Biological Opinion will expire in May and June of 2015, respectively. The NWTT EIS combines both the NWTRC and the NUWC Keyport Range Complex analysis; therefore, the earlier NWTRC MMPA and ESA dates will drive the requirements for NWTT permit completion.

To complete the analysis required by the permitting and consultation process, the Navy and the National Marine Fisheries Service (NMFS) will need to work together. Therefore, in accordance with the Council on Environmental Quality's (CEQ) NEPA guidelines (specifically

40 CFR Part 1501) and CEQ's 2002 guidance on cooperating agencies, the Navy requests that NMFS serve as a cooperating agency for the development of the NWTT EIS/OEIS.

As the lead agency, the Navy will be responsible for overseeing preparation of the EIS/OEIS that includes, but is not limited to, the following:

- Gathering all necessary background information and preparing the EIS/OEIS and all necessary permit applications associated with acoustic issues within the NWTT Study Area.
- Working with NMFS personnel to determine the method of estimating potential effects to protected marine species, including threatened and endangered species.
- Determining the scope of the EIS/OEIS, including the alternatives evaluated.
- Circulating the appropriate NEPA documentation to the general public and any other interested parties.
- Scheduling and supervising meetings held in support of the NEPA process, and compiling any comments received.
- Maintaining an administrative record and responding to any Freedom of Information Act requests relating to the EIS/OEIS.

The Navy respectfully requests that NMFS, in its role as a cooperating agency, provide support as follows:

- Provide timely comments after the Agency Information Meeting (which will be held at the onset of the EIS/OEIS process) and on working drafts of the EIS/OEIS documents. The Navy requests that comments on draft EIS/OEIS documents (Version 2) be provided within 30 working days.
- Respond to Navy requests for information, in particular, those related to review of the acoustic effects analysis and evaluation of the effectiveness of protection and mitigation measures.
- Coordinate, to the maximum extent practicable, any public comment periods that are necessary in the MMPA permitting process with the Navy's NEPA public comment periods.
- Participate, as necessary, in meetings hosted by the Navy for discussion of issues related to the EIS/OEIS, including public hearings and meetings.
- Adhere to the overall schedule as set forth by the Navy.
- Provide a formal, written response to this request.

2

The Navy views this agreement as important to the successful completion of the environmental planning process for the NWTT EIS/OEIS. It is the Navy's goal to complete the analysis as expeditiously as possible, while using the best scientific information available. National Marine Fisheries Service assistance will be invaluable in this endeavor.

The point of contact for this action is Ms. Karen M. Foskey, (703) 695-5193, email: Karen.Foskey@navy.mil.

Sincerely,

JOHN P. QUINN
Deputy Director, Energy and Environmental
Readiness Division (OPNAV N45)

Copy to:
OPNAV N43
Commander, U.S. Fleet Forces Command (N46)
Commander, U.S. Pacific Fleet (N01CE)
Commander, Naval Installations Command (N45)
Commander, Naval Sea Systems Command
Commander, Naval Air Systems Command
Commander, Navy Region Northwest (N40)
Commander, Navy Region Southwest (N40)
Commander, Naval Facilities Engineering Command, Northwest (N45)
Commander, Naval Facilities Engineering Command, Southwest (N45)

3

Enclosure 1: Northwest Training and Testing (NWTT) Study Area

4

Enclosure 2: NOTIONAL SCHEDULE OF EVENTS

NORTHWEST TRAINING AND TESTING
ENVIRONMENTAL IMPACT STATEMENT/
OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS)

Notice of Intent Published in Federal Register	February 2012
Scoping Meetings	March 2012
Request for Marine Mammal Protection Act Letter of Authorization to National Marine Fisheries Service	July 2013
Draft Environmental Impact Statement Notice of Availability	October 2013
Draft Environmental Impact Statement Public Hearings	Oct-Nov 2013
Final Environmental Impact Statement Notice of Availability	April 2015
Record of Decision	July 2015

5

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1315 East-West Highway
Silver Spring, Maryland 20910
THE DIRECTOR

Mr. John P. Quinn
Deputy Director, Energy and
Environmental Readiness Division
Department of the Navy
2000 Navy Pentagon
Washington, DC 20350-2000

JUL 11 2013

Dear Mr. Quinn:

Thank you for your letter requesting that NOAA's National Marine Fisheries Service (NMFS) participate as a cooperating agency in the preparation of an Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to evaluate potential environmental effects of military readiness training and research, development, testing, and evaluation (RDT&E) activities conducted within the Northwest Training and Testing (NWTT) Study Area. We reaffirm our support of the Navy's decision to prepare an EIS/OEIS and agree to be a cooperating agency, due, in part, to our responsibilities under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) and section 7 of the Endangered Species Act.

In response to your letter, NMFS staff will continue to, to the extent possible,

- Provide timely review and comments, within 30 working days, after the Agency Information Meeting and on working drafts of the EIS/OEIS documents;
- Respond to Navy requests for information, in particular those related to the acoustic effects analysis and the evaluation of the effectiveness of protection and mitigation measures, in a timely manner;
- Participate in meetings, as necessary, hosted by the Navy to discuss issues related to the EIS/OEIS, including public hearings on the draft EIS/OEIS; and
- Adhere to the overall schedule as agreed upon by NMFS and the Navy.

If you need any additional information, please contact Ms. Jolie Harrison, NMFS Office of Protected Resources, at (301) 427-8401.

Sincerely,

Samuel D. Rauch, III
Deputy Assistant Administrator
for Regulatory Programs,
performing the functions and duties of the
Assistant Administrator for Fisheries

THE ASSISTANT ADMINISTRATOR
FOR FISHERIES

Printed on Recycled Paper

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350-2000

5090
N454/12U158072
16 February 2012

Mr. Rowan W. Gould
Acting Director
U.S. Fish and Wildlife Service
1849 C Street, NW
Washington, D.C. 20240

Dear Mr. Gould:

In accordance with the National Environmental Policy Act (NEPA), the United States (U.S.) Department of the Navy (Navy) is initiating the preparation of an Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) to assess the potential environmental impacts associated with two categories of Navy readiness activities: training and testing that include the use of active sonar and explosives in the Northwest Training and Testing (NWTT) Study Area. The NWTT Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, located adjacent to the northwest coast of the United States, and areas within the Strait of Juan de Fuca, Puget Sound, and the Behm Canal in southeastern Alaska. The NWTT Study Area (Study Area) includes four existing range complexes and facilities: the Northwest Training Range Complex, the Naval Undersea Warfare Center (NUWC) Keyport Range Complex, Carr Inlet Operations Area, and the Southeast Alaska Acoustic Measurement Facility (SEAFAC). In addition to these range complexes, the Study Area also includes select Navy pierside locations and inland waters that are not part of the range complexes where training and sonar testing may occur.

An important aspect of the NWTT EIS/OEIS will be the analysis of the potential effects to species protected under the Endangered Species Act (ESA). The NWTT EIS/OEIS is also intended to serve as a basis for the renewal of current regulatory permits and authorizations; address current training and testing not covered under the existing permits and authorizations; and obtain those permits and authorizations necessary to support force structure changes and emerging and future training and testing requirements. The ESA Section 7 Programmatic Biological Opinion for NWTRC will expire in August 2015. The Programmatic Biological Opinion for NUWC Keyport expires in March 2016. The NWTT EIS combines both the NWTRC and the NUWC Keyport Range Complex, therefore, the earlier NWTRC ESA dates will drive the requirements for NWTT permit completion.

To complete the analysis required by the permitting and consultation process, the Navy and the U.S. Fish and Wildlife Service (USFWS) will need to work together. Therefore, in accordance with the Council on Environmental Quality's (CEQ) NEPA guidelines (specifically 40 CFR Part 1501) and CEQ's 2002 guidance on cooperating agencies, the Navy requests that USFWS serve as a cooperating agency for the development of the NWTT EIS/OEIS.

As the lead agency, the Navy will be responsible for overseeing preparation of the EIS/OEIS that includes, but is not limited to, the following:

- Gathering all necessary background information and preparing the EIS/OEIS and all necessary permit applications associated with acoustic issues within the NWTT Study Area.
- Working with U.S. Fish and Wildlife Service personnel to determine the method of estimating potential effects to threatened and endangered species.
- Determining the scope of the EIS/OEIS, including the alternatives evaluated.
- Circulating the appropriate NEPA documentation to the general public and any other interested parties.
- Scheduling and supervising meetings held in support of the NEPA process, and compiling any comments received.
- Maintaining an administrative record and responding to any Freedom of Information Act requests relating to the EIS/OEIS.

The Navy respectfully requests U.S. Fish and Wildlife Service, in its role as a cooperating agency, provide support as follows:

- Provide timely comments after the Agency Information Meeting (which will be held at the onset of the EIS/OEIS process) and on working drafts of the EIS/OEIS documents. The Navy requests that comments on draft EIS/OEIS documents (Version 2) be provided within 30 working days.
- Respond to Navy requests for information, in particular, those related to review of the acoustic effects analysis and evaluation of the effectiveness of protection and mitigation measures.
- Participate, as necessary, in meetings hosted by the Navy for discussion of issues related to the EIS/OEIS, including public hearings and meetings.
- Adhere to the overall schedule as set forth by the Navy.
- Provide a formal, written response to this request.

The Navy views this agreement as important to the successful completion of the environmental planning process for the NWTT EIS/OEIS. It is the Navy's goal to complete the analysis as expeditiously as possible, while using the best scientific information available. U.S. Fish and Wildlife Service assistance will be invaluable in this endeavor.

2

The point of contact for this action is Ms. Karen M. Foskey, (703) 695-5193, email: Karen.Foskey@navy.mil.

Sincerely,

JOHN P. QUINN
Deputy Director, Energy and Environmental
Readiness Division (OPNAV N45)

Copy to:
OPNAV N43
Commander, U.S. Fleet Forces Command (N46)
Commander, U.S. Pacific Fleet (N01CE)
Commander, Naval Installations Command (N45)
Commander, Naval Sea Systems Command
Commander, Naval Air Systems Command
Commander, Navy Region Northwest (N40)
Commander, Navy Region Southwest (N40)
Commander, Naval Facilities Engineering Command, Northwest (N45)
Commander, Naval Facilities Engineering Command, Southwest (N45)
Ms. Robyn Thorson, Regional Director, U.S. Fish and Wildlife Service, Pacific Region, 911 NE 11th Avenue, Portland, OR 97232

3

Enclosure 1: Northwest Training and Testing (NWTT) Study Area

4

Enclosure 2: NOTIONAL SCHEDULE OF EVENTS

NORTHWEST TRAINING AND TESTING
ENVIRONMENTAL IMPACT STATEMENT/
OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS)

Notice of Intent Published in Federal Register	February 2012
Scoping Meetings	March 2012
Navy Initiates Section 7 Consultation	April 2014
Draft Environmental Impact Statement Notice of Availability	October 2013
Draft Environmental Impact Statement Public Hearings	Oct-Nov 2013
Final Environmental Impact Statement Notice of Availability	April 2015
Record of Decision	July 2015

5

DEPARTMENT OF THE NAVY
COMMANDER
UNITED STATES PACIFIC FLEET
250 MAKALAPA DRIVE
PEARL HARBOR, HAWAII 96860-3131

IN REPLY REFER TO:
5090
Ser N01CE1/1349
12 Nov 2013

Vice Admiral Paul F. Zukunft, USCG
Commander, Pacific Area/
Commander, Coast Guard Defense West Area
Building 51-6
Coast Guard Island
Alameda, CA 94501

Dear Admiral Zukunft:

Subj: NORTHWEST TRAINING AND TESTING (NWTT) ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS) - COOPERATING AGENCY

In accordance with the National Environmental Policy Act (NEPA), the United States Department of the Navy is initiating the preparation of an Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) to assess the potential environmental impacts associated with training and testing activities that include the use of active sonar and explosives in the Northwest Training and Testing (NWTT) Study Area.

The NWTT Study Area is composed of established maritime operating and warning areas in the eastern North Pacific Ocean region, located adjacent to the northwest coast of the United States, and areas within the Strait of Juan de Fuca, Puget Sound, and the Behm Canal in southeastern Alaska. The Study Area includes four existing range complexes and facilities: the Northwest Training Range Complex, the Naval Undersea Warfare Center Keyport Range Complex, the Carr Inlet Operations Area, and the Southeast Alaska Acoustic Measurement Facility.

In addition to these range complexes, the Study Area also includes select Navy pierside locations and inland waters that are not part of the range complexes where training and sonar testing may occur.

An important aspect of the NWTT EIS/OEIS will be the analysis of the potential effects to marine species protected under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). The NWTT EIS/OEIS is also intended to serve as a basis for the renewal of current regulatory permits and authorizations, address current training and testing not covered under the existing permits and authorizations, and obtains those permits and authorizations necessary to support force structure changes and emerging and future training and testing requirements.

Subj: NORTHWEST TRAINING AND TESTING (NWTT) ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS) - COOPERATING AGENCY

The proposed action of the EIS/OEIS is to conduct training and testing activities within the NWTT study area. The purpose of the proposed action is to achieve and maintain military readiness to meet the requirements of Title 10 of the U.S. Code, thereby ensuring that the Navy meets its mission to train and equip combat-ready forces capable of winning wars, deterring aggression, and maintaining freedom of the seas.

It has been identified that the U.S. Coast Guard conducts training activities within the NWTT Study Area, some of which are similar in nature to activities conducted by Navy units, and it has been determined that it would be appropriate to specifically incorporate Coast Guard at-sea gunnery training activities in the NWTT EIS/OEIS.

Therefore, in accordance with the Council on Environmental Quality's (CEQ) NEPA guidelines (specifically 40 CFR Part 1501) and CEQ's 2002 guidance on cooperating agencies, the Navy requests that the Coast Guard serves as a cooperating agency for the development of the NWTT EIS/OEIS.

As defined in 40 CFR Part 1501.6, the Navy is the lead agency for the NWTT EIS/OEIS. As the lead agency, the Navy shall:

- Request the participation of each cooperating agency in the NEPA process at the earliest possible time.
- Use the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise, to the maximum extent possible consistent with its responsibility as lead agency.
- Meet with the Coast Guard to discuss the EIS/OEIS process as requested.
- Circulate the appropriate NEPA documentation to the general public and any other interested parties.
- Schedule and supervise meetings held in support of the NEPA process, and compiling any comments received.
- Maintain an administrative record and response to any Freedom of Information Act requests relating to the EIS/OEIS.

Navy respectfully requests the Coast Guard, in its role as a cooperating agency, provide support as follows:

- Participate in the NEPA process.

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Subj: NORTHWEST TRAINING AND TESTING (NWTT) ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS) - COOPERATING AGENCY

- Provide data to the Navy on Coast Guard activities that take place in the NWTT EIS/OEIS study area.
- Assume, on request of the Navy, responsibility for developing information and preparing environmental analyses, for which the Coast Guard has special expertise.
- Make available staff support at the lead agency's request to enhance the Navy's interdisciplinary capability.
- Participate, as necessary, in meetings hosted by the Navy for discussion of issues related to the EIS/OEIS.
- Utilize Coast Guard resources, including funding where appropriate, to support role as cooperating agency.
- Adhere to the overall schedule as set forth by the Navy.
- Provide a formal, written response to this request.

The Navy views this agreement as important to the successful completion of the environmental planning process for the NWTT EIS/OEIS. It is the Navy's goal to complete the analysis as expeditiously as possible, while using the best scientific information available. The Coast Guard's assistance will be invaluable in this endeavor.

We appreciate your consideration of our request and look forward to your response. The point of contact for this action is Mr. John Mosher, COMPACFLT N01CE1JM at (360) 257-3234, email: john.g.mosher@navy.mil.

Very respectfully,

B J Muilenburg

B. J. MUILENBURG
Fleet Civil Engineer

Copy to:
OPNAV WASH DC (N45)
COMNAVSEASYSCOM WASH DC
COMNAVAIRSYSCOM PATXENT RIVER MD
COMNAVREG NW SEATTLE WA (N40)

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U.S. Department of Homeland Security
United States Coast Guard

Commander
United States Coast Guard
Pacific Area

Coast Guard Island,
BLDG. 51-6
Alameda, CA 94501-5100
Staff Symbol: PAC-00
Phone: (510) 437-3522
Fax: (510) 437-3774

16475

MEMORANDUM

From: P. F. Zukunft, VADM 12/20/13
CG PACAREA (PAC-00)

LCDR R. Brubaker
(510) 437-3643

To: RDML B. J. Muilenburg
Fleet Civil Engineer
United States Pacific Fleet

Subj: NORTHWEST TRAINING AND TESTING (NWTT) ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS) – COOPERATING AGENCY

Ref. (a) Your letter 5090 of 12 Nov 2013

1. The Coast Guard is pleased to accept the offer, as per reference (a), to participate as a cooperating agency in the subject EIS/OEIS. Doing so will materially further the Coast Guard's interest in the use of Navy range complexes for necessary Coast Guard weapons and military readiness training and will assist in mutual efforts associated with the operation of the Range Complex and establishment of safety zones in accordance with 33 Code of Federal Regulations (CFR) Part 165. As the Coast Guard is a military service and a branch of the Armed Forces, we believe that this action is, and will remain, in full compliance with 40 CFR Part 1501 and the council on Environmental Quality Cooperating Agency guidance issued on 30 January 2002.

2. The Coast Guard agrees with the Navy's statements on pages 2 and 3 of reference (a) concerning the Navy's actions as the lead agency in the EIS/OEIS. As a cooperating agency, the Coast Guard will, to the extent allowed by available resources and fiscal constraints:

- Participate in the NEPA process;
- Provide data to the Navy on Coast Guard activities and operations that take place in the NWTT EIS/OEIS study areas;
- Assume, on request of the Navy, responsibility for developing information and preparing environmental analyses, for which the Coast Guard has special expertise;
- Make available staff support at the lead agency's request to enhance the Navy's interdisciplinary capability, consistent with operational requirements;

Subj: NORTHWEST TRAINING AND TESTING (NWTT) ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS) – COOPERATING AGENCY 16475

- Participate, as necessary, in meetings hosted by the Navy for discussion of issues related to the EIS/OEIS;
- Utilize available Coast Guard resources, including funding where appropriate and available, to support our role as a cooperating agency; and
- Adhere to the overall schedule as set forth by the Navy.

3. As a cooperating agency, I request that the U.S. Coast Guard, as an armed force of the United States within the Department of Homeland Security, be expressly mentioned and described in the NWTT EIS/OEIS, and our operations and activities that take place in the study area be analyzed for environmental effects. To assist the Navy, the Coast Guard is providing operational data to the Navy on Coast Guard operations and activities that take place in the NWTT EIS/OEIS study areas, and we will continue to do so as necessary and appropriate.

4. This memo constitutes the formal written response requested by your letter. I request that the Navy supply the Coast Guard with two preliminary copies of all draft and final NWTT EISs/OEISs for our review of these documents, with a minimum 14 day response period in each instance. This action is important to the successful completion of the environmental planning process for the NWTT EIS/OEIS. We look forward to working with the Navy to facilitate mission accomplishment through productive use of the Northwest Training and Testing Range Complex.

5. The Coast Guard point of contact for all correspondence and exchanges of information with the Navy concerning the NWTT EIS/OEIS is Mr. Brad McKitrick, CG-OES-4 at (202) 372-1443, Bradley.K.McKitrick@uscg.mil.

#

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Appendix D: Air Quality Example Calculations

TABLE OF CONTENTS

APPENDIX D AIR QUALITY EXAMPLE CALCULATIONS D-1

D.1 SURFACE OPERATIONS EMISSIONS D-1
D.1.1 MARINE OUTBOARD ENGINES D-1
D.1.2 DIESEL ENGINES D-2
D.2 AIR OPERATIONS EMISSIONS D-2
D.3 ORDNANCE AND MUNITIONS EMISSIONS D-3
D.4 EMISSIONS ESTIMATES SPREADSHEETS D-3
D.5 EXAMPLE RECORD OF NON-APPLICABILITY D-7

LIST OF TABLES

TABLE D-1: UNITED STATES ENVIRONMENTAL PROTECTION AGENCY EMISSION FACTORS FOR OUTBOARD ENGINES D-1
TABLE D-2: AIR EMISSIONS OF VESSELS DURING TRAINING, NO ACTION ALTERNATIVE, NORTHWEST TRAINING AND TESTING D-4
TABLE D-3: EMISSIONS OF AIRCRAFT DURING TRAINING, NO ACTION ALTERNATIVE, NORTHWEST TRAINING AND TESTING D-5
TABLE D-4: AIR EMISSIONS OF ORDNANCE DURING TRAINING, NO ACTION ALTERNATIVE, NORTHWEST TRAINING AND TESTING D-6

LIST OF FIGURES

FIGURE D-1: SAMPLE RECORD OF NON-APPLICABILITY MEMORANDUM D-7
FIGURE D-2: SAMPLE RECORD OF NON-APPLICABILITY FORM D-8

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APPENDIX D AIR QUALITY EXAMPLE CALCULATIONS

This appendix discusses emission factor development, calculations, and assumptions used in the air quality analyses presented in Section 3.2 (Air Quality) of the Environmental Impact Statement (EIS)/Overseas EIS (OEIS).

D.1 SURFACE OPERATIONS EMISSIONS

Surface operations are activities associated with vessel movements. Fleet training activities use a variety of marine vessels, including cruisers, destroyers, frigates, carriers, submarines, amphibious vessels, and small boats. Testing activities use a variety of marine vessels, including various testing support vessels, work boats, torpedo recovery vessels, unmanned surface vehicles, and small boats. These vessels use diverse propulsion methods, including marine outboard engines, diesel engines, and gas turbines.

D.1.1 MARINE OUTBOARD ENGINES

The United States (U.S.) Environmental Protection Agency (USEPA) has published emissions factors for air pollutants produced by several types of two-stroke and four-stroke outboard engines. Representative emission factors for two-stroke and four-stroke engines of various horsepower are presented in Table D-1.

Table D-1: United States Environmental Protection Agency Emission Factors for Outboard Engines

Engine		Emissions Factor (grams/hp-hr.)			
Type	Rating (horsepower)	NO_x	CO	VOC	PM
2-Stroke	16–25	4.32	79.32	18.69	0.26
	50–100	4.32	79.32	15.55	0.22
4-Stroke	16–25	5.82	166.46	4.65	0.06
	60–100	5.82	127.94	3.53	0.06

Notes: CO = carbon monoxide, hp = horsepower, hr. = hour, NO_x = nitrogen oxides, VOC = volatile organic compounds, PM = Particulate Matter
Source: U.S. Environmental Protection Agency, 2010, *Exhaust Emissions Factors for Non-Road Engine Modeling-Spark Ignition*. Report No. NR-010f; Office of Mobile Sources, Assessment and Modeling Division, EPA-420-R-10-019.

Emissions for surface craft using outboard engines were calculated using USEPA AP-42 factors, multiplied by the engine horsepower and hours of operation.

$$Emissions = HP \times HR/YR \times EF \times ENG$$

Where:

Emissions = annual surface craft emissions
HP = horsepower (reflective of a particular load factor/engine power setting)
HR/YR = hours per year
EF = air pollutant emission factor for specific engine type
ENG = number of engines per vessel

To obtain the total criteria pollutant emissions for the Proposed Action, emissions were calculated for each training or testing activity, type of surface vessel, and criteria pollutant. These individual estimates of emissions, in units of tons per year, were then summed by criteria pollutant to obtain the aggregate emissions for surface vessel emissions activities.

D.1.2 DIESEL ENGINES

Limited data were available for large marine diesel engines. Therefore, USEPA AP-42 emissions factors for industrial reciprocating engines were used to calculate diesel engine emissions. Other sources of vessel emissions factors included data presented in John J. McMullen Associates, as referenced in previous U.S. Department of the Navy (Navy) EIS/OEIS documentation. Diesel was assumed to be the primary fuel to ensure a conservative estimate. Calculation methods similar to those described for marine outboard engines were used to obtain emissions estimates for diesel engines.

$$Emissions = HP \times HR/YR \times EF \times ENG$$

Where:

Emissions = annual surface craft emissions
HP = horsepower (reflective of a particular load factor/engine power setting)
HR/YR = hours per year
EF = air pollutant emission factor for specific engine type
ENG = number of engines per vessel

Diesel engine emission factors were multiplied by the engine horsepower and annual hours of operation to calculate the pollutant emissions per year.

D.2 AIR OPERATIONS EMISSIONS

Fleet training and Naval Air Systems Command testing use various aircraft, including the F/A-18, P-3, SH-60B, MH-60S, and Lear Jet. Research, development, test, and evaluation (RDT&E) air operations use various aircraft, including the 1UH-1N, SH-60B, and MH-60S. Aircraft operations of concern are those that occur from ground level up to 3,000 feet (ft.) (914 meters [m]) above ground level (AGL). The 3,000 ft. (914 m) AGL altitude was assumed to be the ceiling of the mixing zone (known as the atmospheric mixing height) above which any pollutant generated would not contribute to increased pollutant concentrations at ground level. Pollutants emitted by aircraft above 3,000 ft. (914 m) AGL are excluded from the analysis of compliance with National Ambient Air Quality Standards. The pollutant emission rate is a function of the aircraft engine's fuel flow rate and efficiency. Emissions for one complete training activity for a particular aircraft are calculated by knowing the specific engine pollutant emission factors for each mode of operation.

For this EIS/OEIS, emission factors for most military engines were obtained from the Navy's Aircraft Environmental Support Office memoranda and the Federal Aviation Administration's Emissions and Dispersion Modeling System model). For those aircraft for which engine data were unavailable, an applicable surrogate was used. Using these data, as well as number of sorties, pollutant emissions for each aircraft were calculated by applying the equation below.

$$Emissions = T \times N x FF \times EF \times ENG \times CF$$

Where:

Emissions = annual aircraft emissions (pounds[lb.]) (for EF in lb./1,000 gallons [gal.] fuel)
T = time at a specified power setting (hours [hr.]/activity).
N = Number of aircraft operations per year for each type of aircraft
FF = fuel flow at a specified power setting (gal./hr./engine)
EF = pollutant emission factor by engine type and power setting (lb./1,000 gal. of fuel used)

ENG = number of engines per aircraft
CF = conversion factor (0.001)

D.3 Ordnance and Munitions Emissions

Available emissions factors (AP-42, *Compilation of Air Pollutant Emission Factors*) were used. These factors were then multiplied by the net weight of the explosive and the number of items that were used per year. This calculation provides estimates of annual emissions.

$$Emissions = EXP/YR \times EF \times Net\ Wt$$

Where:

Emissions = annual ordnance emissions
EXP/YR = number of explosives, propellants, and pyrotechnics items used per year
EF = air pollutant emissions factor per item
Net Wt = net weight of explosive, propellant, or pyrotechnics per ordnance item

D.4 Emissions Estimates Spreadsheets

The following spreadsheets are examples of the emissions calculations for aircraft, vessels, and ordnance. Tables D-2, D-3, and D-4 provide example calculations for the air quality calculations for vessels, aircraft, and ordnance, respectively. The examples provided are for baseline training within the Northwest Range Complex. These examples are representative of calculation spreadsheets developed for each range or testing area and of the calculations developed for each alternative analyzed in this EIS/OEIS.

Table D-2: Air Emissions of Vessels during Training, No Action Alternative, Northwest Training and Testing

Air Quality Control Region	Activity	Vessel	Annual Hours	CRITERIA AIR POLLUTANTS (pounds/year)																				
				Below 3,000 feet agl					Below 3,000 feet agl - State					Below 3,000 feet agl - Federal					Below 3,000 feet agl - International				
				CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}
TRAINING																								
Northwest Air Basin, Washington	**Anti-Surface Warfare**																							
	Gunnery Exercise (Surface-to-Surface) Boat	DDG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		FFG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		AOE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Region Air Basin, Washington	**Anti-Air Warfare**																							
	Gunnery Exercise (Surface-to-Air)	DDG	46.08	2,458	1,240	181	489	65	0	0	0	0	0	0	0	0	0	0	2,458	1,240	181	489	65
		FFG	136.32	8,182	5,324	793	1,096	293	0	0	0	0	0	0	0	0	0	0	8,182	5,324	793	1,096	293
		AOE	11.52	38	227	29	682	137	0	0	0	0	0	0	0	0	0	0	38	227	29	682	137
	Anti-Surface Warfare																							
	Gunnery Exercise (Surface-to-Surface) Ship	DDG	20.7	2,208	1,114	162	439	58	0	0	0	0	0	0	0	0	0	0	2,208	1,114	162	439	58
		FFG	63	7,563	4,921	733	1,013	271	0	0	0	0	0	0	0	0	0	0	7,563	4,921	733	1,013	271
		AOE	1.8	12	71	9	213	43	0	0	0	0	0	0	0	0	0	0	12	71	9	213	43
Northwest Oregon Intrastate, Oregon	**Anti-Air Warfare**																							
	Gunnery Exercise (Surface-to-Air)	DDG	11.52	614	310	45	122	16	0	0	0	0	0	0	0	0	0	0	614	310	45	122	16
		FFG	34.08	2,045	1,331	198	274	73	0	0	0	0	0	0	0	0	0	0	2,045	1,331	198	274	73
		AOE	2.88	10	57	7	171	34	0	0	0	0	0	0	0	0	0	0	10	57	7	171	34
	Anti-Surface Warfare																							
	Gunnery Exercise (Surface-to-Surface) Ship	DDG	12.42	1,325	669	97	264	35	0	0	0	0	0	0	0	0	0	0	1,325	669	97	264	35
		FFG	37.8	4,538	2,953	440	608	163	0	0	0	0	0	0	0	0	0	0	4,538	2,953	440	608	163
		AOE	1.08	7	43	5	128	26	0	0	0	0	0	0	0	0	0	0	7	43	5	128	26
Portland Intrastate, Oregon	**Anti-Air Warfare**																							
	Gunnery Exercise (Surface-to-Air)	DDG	11.52	614	310	45	122	16	0	0	0	0	0	0	0	0	0	0	614	310	45	122	16
		FFG	34.08	2,045	1,331	198	274	73	0	0	0	0	0	0	0	0	0	0	2,045	1,331	198	274	73
		AOE	2.88	10	57	7	171	34	0	0	0	0	0	0	0	0	0	0	10	57	7	171	34
	Anti-Surface Warfare																							
	Gunnery Exercise (Surface-to-Surface) Ship	DDG	12.42	1,325	669	97	264	35	0	0	0	0	0	0	0	0	0	0	1,325	669	97	264	35
		FFG	37.8	4,538	2,953	440	608	163	0	0	0	0	0	0	0	0	0	0	4,538	2,953	440	608	163
		AOE	1.08	7	43	5	128	26	0	0	0	0	0	0	0	0	0	0	7	43	5	128	26
Southwest Oregon Intrastate, Oregon	**Anti-Air Warfare**																							
	Gunnery Exercise (Surface-to-Air)	DDG	11.52	614	310	45	122	16	0	0	0	0	0	0	0	0	0	0	614	310	45	122	16
		FFG	34.08	2,045	1,331	198	274	73	0	0	0	0	0	0	0	0	0	0	2,045	1,331	198	274	73
		AOE	2.88	10	57	7	171	34	0	0	0	0	0	0	0	0	0	0	10	57	7	171	34
	Anti-Surface Warfare																							
	Ship	DDG	12.42	1,325	669	97	264	35	0	0	0	0	0	0	0	0	0	0	1,325	669	97	264	35
		FFG	37.8	4,538	2,953	440	608	163	0	0	0	0	0	0	0	0	0	0	4,538	2,953	440	608	163
		AOE	1.08	7	43	5	128	26	0	0	0	0	0	0	0	0	0	0	7	43	5	128	26
Northern California Air Basin, California	**Anti-Air Warfare**																							
	Gunnery Exercise (Surface-to-Air)	DDG	11.52	614	310	45	122	16	0	0	0	0	0	0	0	0	0	0	614	310	45	122	16
		FFG	34.08	2,045	1,331	198	274	73	0	0	0	0	0	0	0	0	0	0	2,045	1,331	198	274	73
		AOE	2.88	10	57	7	171	34	0	0	0	0	0	0	0	0	0	0	10	57	7	171	34
	Anti-Surface Warfare																							
	Ship	DDG	12.42	1,325	669	97	264	35	0	0	0	0	0	0	0	0	0	0	1,325	669	97	264	35
		FFG	37.8	4,538	2,953	440	608	163	0	0	0	0	0	0	0	0	0	0	4,538	2,953	440	608	163
		AOE	1.08	7	43	5	128	26	0	0	0	0	0	0	0	0	0	0	7	43	5	128	26
TRAINING SUBTOTAL (pounds)				54,617	34,344	5,081	10,197	2,253	0	0	0	0	0	0	0	0	0	0	54,617	34,344	5,081	10,197	2,253
TRAINING SUBTOTAL (tons)				**27.31**	**17.17**	**2.54**	**5.10**	**1.13**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**27.3**	**17.2**	**2.5**	**5.1**	**1.1**
TRAINING SUBTOTAL (metric tons)				24.83	15.61	2.31	4.63	1.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.83	15.61	2.31	4.63	1.02

NOTES: DDG - Destroyer; FFG - Frigate; AOE - Fast Combat Support Ship; CO - carbon monoxide; NO_x - nitrogen oxides; VOC - volatile organic compounds; SO_x - sulfur oxides; PM_{10} - particulate matter < 10 microns; ft - feet; agl - above ground level

Table D-3: Emissions of Aircraft during Training, No Action Alternative, Northwest Training and Testing

Air Quality Control Region	Activity	Aircraft	Annual Hours	CRITERIA AIR POLLUTANTS (pounds/year)																			
				Below 3,000 feet agl					Below 3,000 feet agl - State					Below 3,000 feet agl - Federal					Below 3,000 feet agl - International				
				CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}
TRAINING																							
Olympic Region Air Basin, Washington	**Anti-Air Warfare**																						
	Air Combat Maneuver	EA-6B	119	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		F-16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Missile Exercise (Air-to-Air)	EA-6B	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Missile Exercise (Surface-to-Air)	P-3C	5	28	130	6	6	61	0.3	1.3	0.1	0.1	0.6	0.3	1.3	0.1	0.1	0.6	0.3	1.3	0.1	0.1	0.6
		Learjet	5	77	20	15	1	4	0.8	0.2	0.1	0.0	0.0	0.8	0.2	0.1	0.0	0.0	0.8	0.2	0.1	0.0	0.0
	Anti-Surface Warfare																						
	Missile Exercise (Air –to-Surface)	P-3C	1	11	52	3	2	24	0	0	0	0	0	0	0	0	0	0	11	52	3	2	24
		SH-60B	2	17	18	2	1	11	0	0	0	0	0	0	0	0	0	0	17	18	2	1	11
		S-3B	0	14	4	2	0	3	0	0	0	0	0	0	0	0	0	0	14	4	2	0	3
Northwest Oregon Intrastate, Oregon	**Anti-Air Warfare**																						
	Missile Exercise (Air-to-Air)	EA-6B	4.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Missile Exercise (Surface-to-Air)	P-3C	1	7	33	2	2	15	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2
		Learjet	1	19	5	4	0	1	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
Portland Intrastate, Oregon	**Anti-Air Warfare**																						
	Missile Exercise (Air-to-Air)	EA-6B	4.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0
	Missile Exercise (Surface-to-Air)	P-3C	1	7	33	2	2	15	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2
		Learjet	1	19	5	4	0	1	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
Southwest Oregon Intrastate, Oregon	**Anti-Air Warfare**																						
	Missile Exercise (Air-to-Air)	EA-6B	4.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0
	Missile Exercise (Surface-to-Air)	P-3C	1	7	33	2	2	15	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2
		Learjet	1	19	5	4	0	1	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
Northern California Air Basin, California	**Anti-Air Warfare**																						
	Missile Exercise (Air-to-Air)	EA-6B	4.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0
	Missile Exercise (Surface-to-Air)	P-3C	1	7	33	2	2	15	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2	0.1	0.3	0.0	0.0	0.2
		Learjet	1	19	5	4	0	1	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0
	TRAINING SUBTOTAL (pounds)			251	374	48	19	171	2	3	0	0	1.3	2	3	0	0	1.3	44	76	6	4	41
	TRAINING SUBTOTAL (tons)			**0.13**	**0.19**	**0.02**	**0.01**	0	**0.00**	**0.00**	**0.00**	**0.00**	0.0	**0.00**	**0.00**	**0.00**	**0.00**	**0.0**	**0.02**	**0.04**	**0.00**	**0.00**	**0.02**
	TRAINING SUBTOTAL (metric tons)			0.11	0.17	0.02	0.01	0	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.0	0.02	0.03	0.00	0.00	0.02

NOTES: CO - carbon monoxide; NO_x - nitrogen oxides; VOC - volatile organic compounds; SO_x - sulfur oxides; PM_{10} - particulate matter < 10 microns; agl - above ground level.

Table D-4: Air Emissions of Ordnance during Training, No Action Alternative, Northwest Training and Testing

Air Quality Control Region	Activity	Item	#	NEW (pounds)		CRITERIA AIR POLLUTANTS (pounds/year)																			
						Below 3,000 feet agl					Below 3,000 feet agl - State					Bewol 3,000 feet agl - federal					Below 3,000 feet agl - International				
				/unit	Total	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}	CO	NO_x	VOC	SO_x	PM_{10}
Olympic Region Air Basin, Washington	**Anti-Air Warfare**																								
	Gunnery Exercise (Surface-to-Air)	Large-Cal Projectile	1,210	8.5	10,282	206	0	0	0	12	0	0	0	0	0	0	0	0	0	0	206	0	0	0	12
		Medium-Cal Projectile	6,400	1.6	10,240	205	0	0	0	12	0	0	0	0	0	0	0	0	0	0	205	0	0	0	12
	Anti-Surface Warfare																								
	Gunnery Exercise (Surface-to-Surface) Ship	Large-Cal Projectile	720	8.5	6,120	122	220	0	0	7	0	0	0	0	0	0	0	0	0	0	122.4	220	0	0	7
		Medium-Cal Projectile	8,190	1.6	13,104	262	472	0	0	16	0	0	0	0	0	0	0	0	0	0	262.08	472	0	0	16
		Small-Cal Projectile	29,250	0.007	205	51	3	0	0	1	0	0	0	0	0	0	0	0	0	0	51.188	3	0	0	1
Puget Sound Air Basin, Washington	**Anti-Air Warfare**																								
	Gunnery Exercise (Surface-to-Air)	Large-Cal Projectile	302	8.5	2,570	51	31	0	0	3	0	0	0	0	0	0	0	0	0	0	51	31	0	0	3
		Medium-Cal Projectile	1,600	1.6	2,560	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
	Anti-Surface Warfare																								
	Gunnery Exercise (Surface-to-Surface) Ship	Large-Cal Projectile	432	8.5	3,672	73	0	0	0	4	0	0	0	0	0	0	0	0	0	0	73	0	0	0	4
		Medium-Cal Projectile	4,914	1.6	7,862	157	0	0	0	9	0	0	0	0	0	0	0	0	0	0	157	0	0	0	9
		Small-Cal Projectile	17,550	0.007	123	31	2	0	0	1	0	0	0	0	0	0	0	0	0	0	31	2	0	0	1
Northwest Oregon Intrastate, Oregon	**Anti-Air Warfare**																								
	Gunnery Exercise (Surface-to-Air)	Large-Cal Projectile	302	8.5	2,570	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
		Medium-Cal Projectile	1,600	1.6	2,560	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
	Anti-Surface Warfare																								
	Gunnery Exercise (Surface-to-Surface) Ship	Large-Cal Projectile	432	8.5	3,672	73	0	0	0	4	0	0	0	0	0	0	0	0	0	0	73.44	0	0	0	4
		Medium-Cal Projectile	4,914	1.6	7,862	157	0	0	0	9	0	0	0	0	0	0	0	0	0	0	157.25	0	0	0	9
		Small-Cal Projectile	17,550	0.007	123	31	2	0	0	1	0	0	0	0	0	0	0	0	0	0	30.713	2	0	0	1
Portland Intrastate, Oregon	**Anti-Air Warfare**																								
	Gunnery Exercise (Surface-to-Air)	Large-Cal Projectile	302	8.5	2,570	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
		Medium-Cal Projectile	1,600	1.6	2,560	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
	Anti-Surface Warfare																								
	Gunnery Exercise (Surface-to-Surface) Ship	Large-Cal Projectile	432	8.5	3,672	73	0	0	0	4	0	0	0	0	0	0	0	0	0	0	73.44	0	0	0	4
		Medium-Cal Projectile	4,914	1.6	7,862	157	0	0	0	9	0	0	0	0	0	0	0	0	0	0	157.25	0	0	0	9
		Small-Cal Projectile	17,550	0.007	123	31	2	0	0	1	0	0	0	0	0	0	0	0	0	0	30.713	2	0	0	1
Southwest Oregon Intrastate, Oregon	**Anti-Air Warfare**																								
	Gunnery Exercise (Surface-to-Air)	Large-Cal Projectile	302	8.5	2,570	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
		Medium-Cal Projectile	1,600	1.6	2,560	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
	Anti-Surface Warfare																								
	Gunnery Exercise (Surface-to-Surface) Ship	Large-Cal Projectile	432	8.5	3,672	73	0	0	0	4	0	0	0	0	0	0	0	0	0	0	73.44	0	0	0	4
		Medium-Cal Projectile	4,914	1.6	7,862	157	0	0	0	9	0	0	0	0	0	0	0	0	0	0	157.25	0	0	0	9
		Small-Cal Projectile	17,550	0.007	123	31	2	0	0	1	0	0	0	0	0	0	0	0	0	0	30.713	2	0	0	1
Northern California Air Basin, California	**Anti-Air Warfare**																								
	Gunnery Exercise (Surface-to-Air)	Large-Cal Projectile	302	8.5	2,570	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
		Medium-Cal Projectile	1,600	1.6	2,560	51	0	0	0	3	0	0	0	0	0	0	0	0	0	0	51	0	0	0	3
	Anti-Surface Warfare																								
	Gunnery Exercise (Surface-to-Surface) Ship	Large-Cal Projectile	432	8.5	3,672	73	0	0	0	4	0	0	0	0	0	0	0	0	0	0	73.44	0	0	0	4
		Medium-Cal Projectile	4,914	1.6	7,862	157	0	0	0	9	0	0	0	0	0	0	0	0	0	0	157.25	0	0	0	9
		Small-Cal Projectile	17,550	0.007	123	31	2	0	0	1	0	0	0	0	0	0	0	0	0	0	30.713	2	0	0	1
TRAINING SUBTOTAL (pounds)						2,666	736	0	0	153	0	0	0	0	0	0	0	0	0	0	2,666	736	0	0	153
TRAINING SUBTOTAL (tons)						**1.3**	**0.4**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.3**	**0.4**	**0.0**	**0.0**	**0.1**
TRAINING SUBTOTAL (metric tons)						1.2	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.3	0.0	0.0	0.1

NOTES: CO - carbon monoxide; NOx - nitrogen oxides; VOC - volatile organic compounds; SOx - sulfur oxides; PM10 - particulate matter < 10 microns; agl - above ground level.

D.5 EXAMPLE RECORD OF NON-APPLICABILITY

This appendix provides an example of the documentation that will be prepared for each state potentially impacted by the Proposed Action. The example document includes a Record of Non-Applicability memorandum, a standard form to show Clean Air Act conformity, and sample conformity analyses.

MEMORANDUM FOR THE RECORD

From: _____

Subj: Conformity Analysis for Northwest Training and Testing (NWTT) Environmental Impact Statement/Overseas Environmental Impact Statement – Operations in State of Washington Waters

Ref: (a) 40 CFR, Part 93, Subpart B: Determining Conformity of General Federal Actions to State or Federal Implementation Plans

Encl: (1) Record of Non-Applicability for Northwest Training and Testing in State of Washington Waters

1. Enclosure (1) is a Record of Non-Applicability for those activities associated with Pacific Fleet training and testing activities that are expected to occur annually in State of Washington waters. The Proposed Action would have no new emissions of criteria air pollutants in air quality non-attainment or maintenance areas.

2. If there are any questions or if additional information is needed, please call _____ at _____.

_____

Name

Title

Figure D-1: Sample Record of Non-Applicability Memorandum

NAVY RECORD OF NON-APPLICABILITY FOR CLEAN AIR ACT CONFORMITY

The Proposed Action falls under the Record of Non-Applicability (RONA) category and is documented with this RONA.

Proposed Action: Northwest Training and Testing

Action Proponents: Commander, Pacific Fleet
Naval Sea Systems Command
Naval Air Systems Command

Proposed Action Name: Northwest Training and Testing (NWTT) Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS)

Proposed Action and Emissions Summary:

The Proposed Action consists of training and testing activities in the waters of the States of Alaska, Washington, Oregon, and California, as well as in federal and international waters. The Proposed Action would result in no increases in emissions of criteria air pollutants in air quality non-attainment or maintenance areas. Accordingly, the Proposed Action is exempt from the provisions of 40 CFR, Part 93, Subpart B.

Affected Air Basins: Northwest Washington Air Quality Control Region, Puget Sound Air Quality Control Region

Date RONA prepared: _____

RONA prepared by: Naval Facilities Engineering Command, Northwest

Attainment Area Status and Emissions Evaluation Conclusion:

To the best of my knowledge and belief, the information contained within this General Conformity Applicability Analysis is correct and accurate. By signing this statement, I am in agreement with the finding that the total of all reasonably foreseeable direct and indirect emissions that will result from this action is below the de minimis threshold set forth in 40 CFR 93.153. Accordingly, it is my determination that this action conforms to the applicable State Implementation Plan (SIP).

RONA Approval:

Signature: _____

Name/Rank: _____ Date: _____

Position: _____ Commanding Officer: _____ Activity: _____

Enclosure 1

Figure D-2: Sample Record of Non-Applicability Form

Appendix E: Public Participation

TABLE OF CONTENTS

APPENDIX E PUBLIC PARTICIPATION E-1

E.1 PROJECT WEBSITE E-1
E.2 GENERAL SUMMARY OF THE SCOPING PERIOD E-1
E.2.1 TRIBAL NOTIFICATION LETTERS E-1
E.2.2 PUBLIC SCOPING NOTIFICATION E-3
E.2.2.1 Scoping Notification Letters E-3
E.2.2.2 Postcard Mailers E-7
E.2.2.3 Press Releases E-7
E.2.2.4 Notification Flier E-8
E.2.2.5 Newspaper Display Advertisements E-8
E.2.3 SCOPING MEETINGS E-9
E.2.4 PUBLIC SCOPING COMMENTS E-9
E.2.4.1 Marine Mammals E-11
E.2.4.2 Sound in the Water/Sonar E-11
E.2.4.3 Underwater Explosions E-11
E.2.4.4 Mitigation E-11
E.2.4.5 Study Area/Size E-11
E.2.4.6 Fish E-12
E.2.4.7 Marine Habitats E-12
E.2.4.8 National Environmental Policy Act Process/Public Participation E-12
E.2.4.9 Navy Activities/Proposed Action E-12
E.2.4.10 Sea Turtles E-12
E.2.4.11 Birds E-12
E.2.4.12 Water Quality E-13
E.2.4.13 Socioeconomics/Commercial and Recreational Fishing E-13
E.2.4.14 Cumulative Impacts E-13
E.2.4.15 Public Health and Safety E-13
E.2.4.16 Other E-13
E.2.4.17 Research E-14
E.2.4.18 Air Quality E-14
E.2.4.19 Marine Debris E-14
E.2.4.20 Terrestrial Resources E-14
E.2.4.21 Noise E-14
E.2.4.22 Cultural Resources/Native American Concerns E-14
E.2.4.23 Access E-14

LIST OF TABLES

TABLE E-1: PUBLIC SCOPING COMMENT SUMMARY E-10

LIST OF FIGURES

There are no figures in this section.

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APPENDIX E PUBLIC PARTICIPATION

This appendix includes information about the public's participation in the development of the Northwest Training and Testing Activities (NWTT) Environmental Impact Statement (EIS)/Overseas EIS (OEIS).

E.1 PROJECT WEBSITE

A public website was established specifically for this project, http://www.NWTTEIS.com/. This website address was published in the *Notice of Intent to Prepare an Environmental Impact Statement and Overseas Impact Statement* (Notice of Intent) and has subsequently been re-printed in all newspaper advertisements, agency letters, and public postcards. The Scoping Meeting Fact Sheets and various other materials will be available on the project website throughout the course of the project.

E.2 GENERAL SUMMARY OF THE SCOPING PERIOD

The public scoping period began with the issuance of the Notice of Intent in the *Federal Register* on 27 February 2012. This notice included a project description and scoping meeting dates and locations. The scoping period lasted 60 days, concluding on 27 April 2012. Sections E.2.1 and E.2.2 describe the United States (U.S.) Department of the Navy's (Navy's) notification efforts during scoping. The scoping period allowed a variety of opportunities for the public to comment on the scope of the EIS/OEIS.

E.2.1 TRIBAL NOTIFICATION LETTERS

Tribal notification letters were distributed on 23 February 2012, to 46 federally recognized tribes and tribal groups. Recipients included:

<u>Washington</u>
Chinook Indian Nation
Confederated Tribes of the Chehalis Reservation
Cowlitz Indian Tribe
Hoh Indian Tribe of the Hoh Indian Reservation
Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Lummi Tribe of the Lummi Reservation
Makah Indian Tribe of the Makah Indian Reservation
Muckleshoot Indian Tribe of the Muckleshoot Reservation
Nisqually Indian Tribe of the Nisqually Reservation
Nooksack Indian Tribe of Washington
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Port Gamble Indian Community of Port Gamble Reservation
Puyallup Tribe of the Puyallup Reservation
Quileute Tribe of the Quileute Reservation
Quinault Indian Nation
Samish Indian Tribe
Sauk-Suiattle Indian Tribe of Washington
Shoalwater Bay Tribe of the Shoalwater Bay Indian Reservation
Skagit River System Cooperative
Skokomish Indian Tribe of the Skokomish Reservation

Snoqualmie Tribe
Squaxin Island Tribe of the Squaxin Island Reservation
Stillaguamish Tribe of Washington
Suquamish Indian Tribe of the Port Madison Reservation
Swinomish Indians of the Swinomish Reservation
Tulalip Tribes of the Tulalip Reservation
Upper Skagit Indian Tribe

Oregon
Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
Confederated Tribes of Grand Ronde Community of Oregon
Confederated Tribes of Siletz Indians of Oregon
Confederated Tribes of the Warm Springs Reservation
Coquille Tribe of Oregon
Cow Creek Band of Umpqua Indians of Oregon
Klamath Tribes

California
Cahto Indian Tribe of the Laytonville Rancheria
Cher-Ae Heights Indian Community of the Trinidad Rancheria
Coyote Valley Band of Pomo Indians
Elk Valley Rancheria
Hoopa Valley Tribe
Hopland Band of Pomo Indians of the Hopland Rancheria
Karuk Tribe
Pinoleville Pomo Nation
Potter Valley Tribe
Redwood Valley Rancheria of Pomo Indians of California
Robinson Rancheria of Pomo Indians of California
Round Valley Indian Tribes of the Round Valley Reservation
Scotts Valley Band of Pomo Indians of California
Sherwood Valley Rancheria of Pomo Indians of California
Smith River Rancheria
Tolowa Nation
Wiyot Tribe
Yurok Tribe of the Yurok Reservation

Alaska
Cape Fox Corporation
Central Council of the Tlingit and Haida Indian Tribes of Alaska
Ketchikan Indian Community
Metlakatla Indian Community, Annette Island Reserve
Organized Village of Saxman
Sealaska

E.2.2 PUBLIC SCOPING NOTIFICATION

The Navy made significant efforts at notifying the public to ensure maximum public participation during the scoping process. A summary of these efforts follows.

E.2.2.1 Scoping Notification Letters

Notice of Intent/Notice of Scoping Meeting letters were distributed on 29 February 2012, to 748 federal, state, and local elected officials and government agencies. Recipients included:

Federal

U.S. Senators (Washington, Oregon, California, Alaska) and Staff
U.S. Representatives (Washington Districts 1, 2, 3, 6, 7, 8, and 9; Oregon Districts 1, 2, 3, 4, and 5; California Districts 1 and 2; and Alaska At-Large District) and Staff
Battelle Pacific Northwest Laboratory
Federal Aviation Administration
- Washington, D.C., Headquarters
- Western Pacific Region

Marine Mammal Commission
U.S. Army Corps of Engineers
- Washington, D.C., Headquarters
- Seattle District

U.S. Department of Commerce
- Washington, D.C., Headquarters
- National Oceanic and Atmospheric Administration (NOAA)
  - National Marine Fisheries Service
    - Northwest Fisheries Science Center
    - Maryland Offices
    - Office of Habitat Conservation
      - Washington Habitat Branch
    - Office of Protected Resources
      - Northwest Region
  - National Marine Protected Areas Center
- Olympic Coast National Marine Sanctuary
- Pacific Fishery Management Council

U.S. Department of Homeland Security
- U.S. Coast Guard
  - District 13
  - District 17
  - Office of Operating and Environmental Standards
- U.S. Army National Guard
  - Oregon Division

U.S. Department of the Interior
- Bureau of Indian Affairs
  - Northwest Regional Office
- Bureau of Land Management
  - Coos Bay District Office
  - Oregon/Washington State Office
  - Spokane District Office

Bureau of Ocean Energy Management, Regulation, and Enforcement
Pacific Outer Continental Shelf Region
Bureau of Safety and Environmental Enforcement
Pacific Outer Continental Shelf Region
Office of Regulation
National Park Service
Olympic National Park
Office of Environmental Policy and Compliance
Portland Region
U.S. Environmental Protection Agency
National Environmental Policy Act (NEPA) Compliance Division
Region X (Seattle)
Environmental Review and Sediment Management Unit
Washington, D.C., Headquarters
U.S. Fish and Wildlife Service
Pacific Regional Office
Washington Maritime Wildlife Refuge Complex
Western Washington Office
U.S. Forest Service
Pacific Northwest Region Office
U.S. Geological Survey
Alaska Science Center
Northwest Area Office
Pacific Northwest Region Office
Southwest Area Office
Western Fisheries Research Center

State of Washington
Office of the Governor
State Senators (Districts 1, 2, 7, 10, 19, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 35, 38, 39, and 44) and Staff
State Representatives (Districts 1, 2, 7, 10, 19, 21, 23, 24, 25, 26, 27, 28, 29, 31, 32, 35, 38, 39, and 44) and Staff
Coastal Advisory Body on Ocean Policy
Puget Sound Partnership
Department of Agriculture
Policy and Communications Department
Department of Archaeology and Historic Preservation
Department of Ecology
Southwest Regional Office
Department of Fish and Wildlife
Region 6
Department of Natural Resources
Fish and Wildlife Commission
Parks and Recreation Commission

State of Oregon
Office of the Governor
State Senators (Districts 1, 5, 16, 28, and 29) and Staff

State Representatives (1, 9, 10, 31, 32, 57) and Staff
Department of Fish and Wildlife
Department of Forestry
Department of Land Conservation and Development
Department of Parks and Recreation
Department of State Lands
Military Department
Department of Environmental Quality
    Water Quality Division
Water Resources Department
Pacific States Marine Fisheries Commission

State of California
Office of the Governor
State Senators (Districts 1, 2, and 4) and Staff
State Assembly Members (District 1) and Staff
California Coastal Commission
    San Francisco Headquarters
    North Coast District Office
Department of Fish and Game
Environmental Protection Agency
Resources Agency
Department of Toxic Substances Control

State of Alaska
Office of the Governor
State Senators (Districts A, B, and C) and Staff
State Representatives (Districts 1, 2, 3, 4, and 5) and Staff
Alaska Marine Highway
Department of Natural Resources
    Division of Forestry
    Division of Geological and Geophysical Surveys
    Division of Mining, Land and Water
    Division of Oil and Gas
    Division of Parks and Outdoor Recreation
    Office of History and Archaeology
    Public Information Center
Department of Commerce
    Community and Economic Development
        Division of Community and Regional Affairs
Department of Environmental Conservation
    Division of Administrative Services
    Division of Air Quality
    Division of Environmental Health
    Division of Spill and Prevention Response
    Division of Water
Department of Fish and Game
    Commercial Fisheries Division

Division of Wildlife Conservation
Habitat Division
Sport Fish Division
Sportfishing
Subsistence Division
Wildlife Conservation Division
Department of Military and Veterans Affairs
Department of Transportation and Public Facilities
Division of Ports and Harbors
Juneau Office
Statewide Aviation Office
Regulatory Commission of Alaska

Local – Washington
City of Aberdeen
City of Bremerton
City of Everett
City of Hoquiam
City of Oak Harbor
City of Ocean Shores
City of Port Townsend
City of Poulsbo
City of Tacoma
City of Westport
County of Clallam
County of Ferry
County Grays Harbor
County of Island
County of Jefferson
County of Kitsap
County of Pacific
County of Pierce
County of San Juan
County of Snohomish
Friday Harbor Airport

Local – Oregon
City of Astoria
City of Bandon
City of Bay City
City of Brookings
City of Cannon Beach
City of Coos Bay
City of Depoe Bay
City of Garibaldi
City of Gearhart
City of Gold Beach
City of Lakeside

City of Lincoln
City of Manzanita
City of Nehalem
City of Newport
City of North Bend
City of Port Orford
City of Reedsport
City of Rockaway Beach
City of Seaside
City of Tillamook
City of Waldport
City of Warrenton
City of Wheeler
City of Yachats
County of Clatsop
County of Coos
County of Curry
County of Lane
County of Lincoln
County of Tillamook
Depoe Bay Nearshore Action Team
Port Orford Watershed Council

Local – California
City of Arcata
City of Crescent
City of Eureka
City of Fort Bragg
City of Point Arena
City of Trinidad
County of Del Norte
County of Humboldt
County of Mendocino
Humboldt County Democratic Central Committee

Local – Alaska
City of Ketchikan
Ketchikan Gateway Borough

E.2.2.2 Postcard Mailers

On 28 February 2012, postcards were mailed to 1,925 organizations and individuals on the NWTT project mailing list, which was compiled, validated, and updated from previous Navy NEPA projects in the Northwest. Postcards included the scoping meeting dates, locations, and times.

E.2.2.3 Press Releases

Three press releases were distributed by the Navy Region Northwest Public Affairs Office to media outlets, elected officials and other potentially interested parties. The news releases were distributed on

27 February 2012, 5 March 2012, and 15 March 2012, respectively, and announced the intent to prepare an EIS/OEIS and provided notice of the open house information sessions. The press releases included information about the Proposed Action and its purpose and need; open house information session locations, dates, and times; and project website and comment submittal information.

E.2.2.4 Notification Flier

A notification flier was distributed to 37 locations in Washington, 18 locations in Oregon, 26 locations in Northern California, and 7 locations in Alaska to be posted in areas frequented by the local community. The flier provided information on the Proposed Action, open house information session locations, dates and times, project website and information on comment submittal. The fliers were mailed on 8 March 2012 and follow-up phone calls were made to ensure posting.

E.2.2.5 Newspaper Display Advertisements

Advertisements were made to announce the scoping meetings in the following counties, cities and newspapers on the dates indicated below:

Kitsap County, Statewide
The Seattle Times
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Wednesday, Mar. 7, 2012
Wednesday, Mar. 14, 2012
Thursday, Mar. 15, 2012
Friday, Mar. 16, 2012

Snohomish County
The Everett Herald
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Tuesday, Mar. 6, 2012
Tuesday, Mar. 13, 2012
Wednesday, Mar. 14, 2012
Thursday, Mar. 15, 2012

Island County
Whidbey News-Times
Wednesday, Feb. 29, 2012
Saturday, Mar. 3, 2012
Wednesday, Mar. 7, 2012
Saturday, Mar. 10, 2012

Kitsap County
The Kitsap Sun
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Thursday, Mar. 8, 2012
Tuesday, Mar. 13, 2012
Wednesday, Mar. 14, 2012
Thursday, Mar. 15, 2012

Clallam/Jefferson County
Peninsula Daily News
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Monday, Mar. 5, 2012
Monday, Mar. 12, 2012
Tuesday, Mar. 13, 2012
Wednesday, Mar. 14, 2012

Jefferson County
Port Townsend and Jefferson County Leader
Wednesday, Feb. 29, 2012
Wednesday, Mar. 7, 2012
Wednesday, Mar. 14, 2012

Grays Harbor County
The Daily World
Tuesday, Feb. 28, 2012
Thursday, Mar. 1, 2012
Friday, Mar. 2, 2012
Thursday, Mar. 8, 2012
Wednesday, Mar. 14, 2012
Thursday, Mar. 15, 2012
Friday, Mar. 16, 2012

Statewide, OR
The Oregonian
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Monday, Mar. 12, 2012
Sunday, Mar. 18, 2012
Monday, Mar. 19, 2012
Tuesday, Mar. 20, 2012

Tillamook, OR
Tillamook Headlight-Herald
Wednesday, Feb. 29, 2012
Wednesday, Mar. 7, 2012
Wednesday, Mar. 14, 2012

Newport, OR
Newport News-Times
Wednesday, Feb. 29, 2012
Friday, Mar. 2, 2012
Wednesday, Mar. 7, 2012
Friday, Mar. 9, 2012
Wednesday, Mar. 14, 2012
Friday, Mar. 16, 2012

Eureka, CA
Eureka Times-Standard
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Thursday, Mar. 1, 2012
Wednesday, Mar. 14, 2012
Tuesday, Mar. 20, 2012
Wednesday, Mar. 21, 2012
Thursday, Mar. 22, 2012

Fort Bragg, CA
Fort Bragg Advocate-News
Thursday, Mar. 1, 2012
Thursday, Mar. 8, 2012
Thursday, Mar. 15, 2012
Thursday, Mar. 22, 2012

Juneau, AK
The Juneau Empire
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Tuesday, Mar. 20, 2012
Sunday, Mar. 25, 2012
Monday, Mar. 26, 2012
Tuesday, Mar. 27, 2012

Ketchikan, AK
Ketchikan Daily News
Monday, Feb. 27, 2012
Tuesday, Feb. 28, 2012
Wednesday, Feb. 29, 2012
Tuesday, Mar. 20, 2012
Saturday, Mar. 24, 2012
Monday, Mar. 26, 2012
Tuesday, Mar. 27, 2012

E.2.3 Scoping Meetings

Nine scoping meetings were held on March 13, 14, 15, 16, 19, 20, 22, 23, and 27 in the cities of Oak Harbor, WA; Quilcene, WA; Silverdale, WA; Aberdeen, WA; Tillamook, OR; Newport, OR; Eureka, CA; Fort Bragg, CA; and Ketchikan, AK, respectively. At each scoping meeting, staffers at the welcome station greeted guests and encouraged them to sign in to be added to the project mailing list to receive future notifications. In total, 238 people signed in at the welcome table. The meetings were held in an open house format, presenting informational posters and written information, with Navy staff and project experts available to answer participants' questions. Additionally, a digital voice recorder was available to record participants' oral comments. The interaction during the information sessions was productive and helpful to the Navy.

What is a scoping meeting?

The scoping period determines the extent of the EIS in terms of significant issues. Scoping meetings allow the face-to-face exchange of information and ideas to ensure relevant topics are identified and properly studied and that the Draft EIS is thorough and balanced.

E.2.4 Public Scoping Comments

Scoping participants submitted comments in five ways:

- Oral statements at the public meetings (as recorded by the digital voice recorder)
- Written comments at the public meetings
- Written letters (received any time during the public comment period)
- Electronic mail (received any time during the public comment period)
- Comments submitted directly on the project website (received any time during the public comment period)

In total, the Navy received comments from 316 individuals and groups. Because many of the comments addressed more than one issue, 1,054 total comments resulted. Table E-1 provides a breakdown of areas of concern based on comments received during scoping. The summary following Table E-1 provides an overview of comments and is organized by area of concern.

Table E-1: Public Scoping Comment Summary

Area of Concern	Count	Percent of Total
Marine Mammals	225	21.3%
Sound in the Water/Sonar	173	16.4%
Underwater Explosions	71	6.7%
Mitigation	59	5.6%
Study Area/Size	57	5.4%
Fish	56	5.3%
Marine Habitats	45	4.3%
National Environmental Policy Act Process/Public Participation	42	4.0%
Navy Activities/Proposed Action	38	3.6%
Sea Turtles	35	3.3%
Birds	30	2.8%
Water Quality	29	2.8%
Socioeconomics/Commercial and Recreational Fishing	29	2.8%
Cumulative Impacts	25	2.4%
Public Health and Safety	24	2.3%
Other	23	2.2%
Research	20	1.9%
Air Quality	18	1.7%
Marine Debris	15	1.4%
Terrestrial Resources	15	1.4%
Noise	11	1.0%
Cultural Resources/Native American Concerns	9	0.9%
Access	5	0.5%
TOTAL	**1,054**	**100.0%**

E.2.4.1 Marine Mammals

A significant number of participants requested the Navy train and test in areas devoid of marine life. Comments expressed a general concern about the Navy's training and testing activities, which include sonar and explosives, and how these activities can harm or kill marine mammals. Many comments requested the need for improved and more effective marine mammal protection measures, particularly since many whale species are declining. Other comments addressed the migration routes of marine mammals and the need for Navy to avoid these to ensure the success of marine species. Comments requested the Navy address hot spots and other methods to actively protect marine mammals.

E.2.4.2 Sound in the Water/Sonar

Comments in this category expressed concern about the use of sonar in biologically diverse areas of the Pacific Northwest, questioned the need for sonar, and requested the Navy stop using sonar in its training and testing activities. Comments questioned the proposed increased use of sonar in Puget Sound and Dabob Bay. Many comments questioned the current research available on the effects of sonar on marine species, and stated that lack of information should force sonar activities to a halt until better research is conducted. Many comments felt current models are inadequate and misrepresent expected take levels. Comments also questioned marine species hearing thresholds of underwater sound at various ranges and cited specific examples where sonar has harmed marine life.

E.2.4.3 Underwater Explosions

Many comments referenced the negative impacts underwater explosives have on marine life. Comments also expressed concerns for public safety. Comments addressed toxic and radioactive materials leached from munitions, bombs and other explosives, and the water contamination that is a result of underwater explosions. Comments referenced L-112, and other marine mammal deaths, and the belief that Navy explosives were the cause. Many comments requested the Navy cease using explosives in such a biologically diverse area.

E.2.4.4 Mitigation

A significant number of participants expressed concerns about current mitigation measures and the inadequate reliance on lookouts to spot marine species. Comments stated that current passive sonar technology should be improved and more sophisticated technology should be designed to more effectively identify and track marine species. Comments stated that the Navy should focus on avoidance of hot spots and migration routes, and even create greater buffer zones away from the coastline. Mitigation measures for aircraft flight paths to minimize routes over residential areas were also suggested. Many comments expressed the need for the Navy to coordinate with other federal, state, and local agencies to develop more effective mitigation measures.

E.2.4.5 Study Area/Size

Most comments regarding the Study Area addressed the need for training and testing in the Pacific Northwest, expressed concern for the lack of designations on the Study Area Map, such as Marine Protected Areas, and questioned the legitimacy of having such a large Study Area. Many comments expressed concern about "the expansion" of training ranges in the Pacific Northwest or requested the Navy train and test farther away from the coastline to create a larger buffer zone for coastal species. Many comments requested the Navy train and test outside the Pacific Northwest in areas with less species diversity. Other comments expressed concern that Puget Sound and the Olympic Coast National Marine Sanctuary are part of the Study Area.

E.2.4.6 Fish

There were several comments about how training and testing activities would impact the albacore, groundfish, salmon, shellfish, and halibut fisheries and subsequent effects on prey. Comments questioned the effects underwater sound from sonar, pile driving, and explosives have on fish and the research that has been put in place to make these determinations. Many comments addressed the need to train elsewhere to reduce harm on fish species that are needed for tourism, recreational, and commercial purposes.

E.2.4.7 Marine Habitats

Comments in this category expressed concern about the impacts Navy training and testing may have on the many marine habitats in the Pacific Northwest that are home to a diversity of species. Comments addressed the need for alternatives and mitigation to focus on habitat management. Protection of breeding habitats was a common theme. Comments specifically addressed the importance of Puget Sound as a feeding ground for many marine species.

E.2.4.8 National Environmental Policy Act Process/Public Participation

A significant number of participants requested a comment period extension, as suggested by the Natural Resources Defense Council, due to perceived poor meeting attendance. Other comments expressed concern with the meeting format, the information provided, and Navy representation by contractors. Some comments, however, expressed appreciation for the information provided and for the subject matter experts present at the open house information sessions. Some comments felt the timing for public meetings was inappropriate because of the lack of information on the cause of death for L-112. Some comments inquired about the cost of meetings, missing documentation on the project website, the website commenting tool, and the locations for the future public hearings.

E.2.4.9 Navy Activities/Proposed Action

Many participants in the comment process wanted detailed documentation of, and reasons for, the types (including types of vessels and aircraft), frequencies and locations of Navy activities conducted in the Pacific Northwest. Many comments expressed opposition to the U.S. military or did not support an increase in Navy training and testing activities. Comments expressed concern about Navy activities that use sonar and explosives, and questioned the need for such activities since there is no imminent threat. Comments also requested the Navy develop new alternatives that have minimal environmental impact. Participants also requested alterations to flight paths and notifications of flight activity.

E.2.4.10 Sea Turtles

There were several comments regarding the impacts sonar and explosives would have on sea turtles and sea turtle habitat. Comments addressed direct impacts that could result when sea turtles are exposed to sound over a certain decibel. Other comments questioned the impacts on sea turtles during training and testing with unmanned systems. Comments generally requested the Navy train and test in areas devoid of marine life, especially outside of the Olympic Coast National Marine Sanctuary.

E.2.4.11 Birds

Natural resource issues mentioned were the impacts training and testing, including the use of sonar, explosives and pile driving, have on birds, particularly threatened and endangered diving bird species, such as the marbled murrelet and short-tailed albatross. Comments in this category specifically addressed the alarming decrease in shorebird and seabird populations in Washington State and

requested recent studies from outside the Navy on these reduced bird populations. Comments also questioned methods of observation and avoidance measures in place. Other comments addressed how toxic materials can impact bird species, stated a lack of attention is given to birds since marine mammals are the more popular species, and requested the Navy be sensitive to the habits and migratory patterns of the birds around Whidbey Island.

E.2.4.12 Water Quality

Concerns in this area were about identifying water bodies likely to be impacted by the project, the nature of the potential impacts and the specific discharges and pollutants likely to impact those waters. Additional comments discussed past exemptions the Navy received allowing excessive pollution of waterways. Water contamination was a prominent topic throughout all comments in this category.

E.2.4.13 Socioeconomics/Commercial and Recreational Fishing

Comments in this category stated how recreational access is vital to the economic base of the Pacific Northwest coastal communities. Several comments questioned the impacts on the tuna, halibut, salmon and shellfish fisheries and groundfish habitat, and requested review of Navy activities for compatibility with commercial and recreational fishery seasons. One recommendation was for the Navy to include notification of exercises on the NOAA weather forecast so that the small boat tuna fleet could have increased awareness. Other comments questioned how Navy activities would impact tourism, which some considered driven by whale watchers, and whether or not fisherman would be reimbursed for economic losses as a result of reduced catches.

E.2.4.14 Cumulative Impacts

Comments on cumulative impacts requested the Navy consider all ocean impacts, such as waste from the tsunami in Japan, oil spills, garbage and discarded fishing nets, when assessing Navy activities. Comments directed the Navy to meaningfully evaluate cumulative impacts on marine species (both in and outside the project area) from underwater noise, sonar and other stressors, including climate change and ocean acidification. Other comments requested the Navy analyze the cumulative impacts from combined and individual Canadian and Navy sonar usage.

E.2.4.15 Public Health and Safety

Comments pertaining to public health and safety requested the Navy engage in direct dialogue with the trawling community and co-develop a mutually acceptable warning system that will alert trawlers when submarines are operating in the same area. Other comments specifically addressed the impacts aircraft flight paths have on residents by disrupting sleep patterns. Additional comments expressed concern about toxic chemicals used in Navy range complexes, including the impact these toxic chemicals have on air and water that residents are exposed to, and the safety risks imposed on residents with the use of drones, weapons, aircraft, sonar, and ships in the Pacific Northwest coastline. Comments requested the Navy clean up hazardous spills and ordnance on all Navy ranges and provide details on the proper disposal of all toxic wastes, hazardous materials, and other waste.

E.2.4.16 Other

This category of comments addressed issues or concerns that were beyond the scope of the NWTT EIS/OEIS. Comments addressed the use of white phosphorus and depleted uranium, inquired about domestic disaster training and coordinating with the Canadian Navy, requested the use of local products to reduce the Navy's environmental footprint, suggested that the actual decision-makers interact with the public, or expressed support for national security.

E.2.4.17 Research

Comments in this category requested the Navy spend more money on researching the physical and behavioral effects sonar and pile driving have on marine mammals. Other comments addressed the need to invest money in technology that better identifies the presence of sea life, and questioned if existing technology has been adequately tested, such as unmanned vehicles, and the true effects these technologies have on sensitive areas. Comments requested the Navy also research and address barosinusitis in whales and dolphins, to better understand species migration patterns, which may lead to altering training routes to reduce impacts, and to continue researching the cause of the recent whale casualty (L-112) in the area.

E.2.4.18 Air Quality

Concerns in this area were the impacts activities would have on air quality, and ultimately, climate change. Comments expressed concerns with the Navy receiving exemptions, which leads to more air pollution, and the Navy's use of aerosols and other toxic airborne chemicals.

E.2.4.19 Marine Debris

Several comments discussed the impacts marine debris, not just from Navy activities, have on the marine environment. Debris references were regarding tsunami debris, old spills, fishing nets, garbage and remnants from explosive materials. Comments also focused on the cleanup of any hazardous materials and spills.

E.2.4.20 Terrestrial Resources

Comments in this category expressed general concerns about how training and testing activities may affect the natural, terrestrial environment and the species that make the land their habitat, especially migratory birds and other wildlife. Comments spoke to the biological balance these species are a part of in the Northwest area.

E.2.4.21 Noise

Several comments about aircraft noise from landings, takeoffs, and flight routes were received. The comments requested adjustments to flight operations to minimize noise and proposed a public website that would inform community members of flight schedules and other Navy activities that may increase noise levels. Other comments expressed concern with evening aircraft activities, and how other noise-intensive activities, such as pile driving and explosions, impact marine species in the Study Area.

E.2.4.22 Cultural Resources/Native American Concerns

Comments in this category requested information on the tribal consultation and coordination process and referenced the need for thorough and comprehensive cultural surveys of potentially affected areas. Additional comments expressed concern with military training and testing occurring on tribal lands and the impacts on tribal resources.

E.2.4.23 Access

Concerns in this area are in regard to year-round access to recreational areas and increased access restrictions on Dabob Bay.

Appendix F: Training and Testing Activities Matrices

TABLE OF CONTENTS

APPENDIX F TRAINING AND TESTING ACTIVITIES MATRICES F-1

F.1 COMPONENTS OF TRAINING ACTIVITIES.....F-3
F.2 COMPONENTS OF TESTING ACTIVITIES.....F-5
F.3 STRESSORS BY TRAINING ACTIVITY F-8
F.4 STRESSORS BY TESTING ACTIVITY F-10
F.5 STRESSORS BY RESOURCE.....F-13

LIST OF TABLES

TABLE F-1: COMPONENTS OF TRAINING ACTIVITIES F-3
TABLE F-2: COMPONENTS OF TESTING ACTIVITIES F-5
TABLE F-3: STRESSORS BY TRAINING ACTIVITY.....F-8
TABLE F-4: STRESSORS BY TESTING ACTIVITY F-10
TABLE F-5: STRESSORS BY RESOURCE F-13

LIST OF FIGURES

There are no figures in this section.

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APPENDIX F TRAINING AND TESTING ACTIVITIES MATRICES

This appendix contains tables that help to describe each of the training and testing activities in terms of their component parts (Table F-1 and Table F-2) and the stressors associated with each activity (Table F-3 and Table F-4). In addition, Table F-5 provides all of the resources analyzed in the Northwest Training and Testing (NWTT) Environmental Impact Statement (EIS)/Overseas EIS (OEIS) and indicates the stressors that could impact each resource area. For a complete explanation of the stressors used in the analysis, see Section 3.0.5.3 (Identification of Stressors for Analysis) in the NWTT EIS/OEIS.

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F.1 COMPONENTS OF TRAINING ACTIVITIES

Table F-1: Components of Training Activities

Training Activity	Electromagnetic Devices	Aircraft Carriers	Surface Combatants	Amphibious Warfare Ships	Support Craft	Submarines	Towed Devices	Unmanned Surface or Underwater Vehicles	Non-Explosive Small-Caliber Projectiles	Non-Explosive Medium-Caliber Projectiles	Non-Explosive Large-Caliber Projectiles	Non-Explosive Bombs	Non-Explosive Missiles	Non-Explosive Torpedoes	Aircraft Stores or Ballast	Non-Explosive Rockets	Non-Explosive Sonobuoys	Parachutes	Chaff	Flares	High-Explosive Munitions	Targets	Seafloor Devices	Fixed-Wing Aircraft	Rotary-Wing Aircraft	Unmanned Aircraft Systems	Fiber Optic Wire	Guidance Wire
ANTI-AIR WARFARE (AAW)																												
Air Combat Maneuver (ACM)																								✓				
Missile Exercise (Air-to-Air)																					✓	✓		✓		✓		
Gunnery Exercise (Surface-to-Air)		✓	✓							✓	✓											✓		✓				
Missile Exercise (Surface-to-Air)		✓	✓										✓								✓	✓		✓		✓		
ANTI-SURFACE WARFARE (ASUW)																												
Gunnery Exercise (Surface-to-Surface) Ship			✓						✓	✓											✓	✓						
Gunnery Exercise (Surface-to-Surface) Boat					✓				✓													✓						
Missile Exercise (Air-to-Surface)													✓								✓	✓		✓	✓			
Bombing Exercise (Air-to-Surface)												✓									✓	✓		✓				
Sinking Exercise (SINKEX)[1]			✓			✓															✓	✓		✓	✓			✓
ANTI-SUBMARINE WARFARE (ASW)																												
Tracking Exercise – Submarine						✓	✓	✓														✓						
Tracking Exercise – Surface			✓			✓	✓	✓									✓	✓				✓						
Tracking Exercise – Helicopter						✓		✓									✓	✓				✓			✓			
Tracking Exercise – Maritime Patrol Aircraft						✓		✓						✓			✓	✓				✓		✓				
Tracking Exercise – Maritime Patrol (Extended Echo Ranging Sonobuoys)						✓		✓				✓					✓	✓			✓			✓				
ELECTRONIC WARFARE (EW)																												
Electronic Warfare Operations (EW Ops)		✓	✓			✓																		✓	✓			
MINE WARFARE (MIW)																												
Mine Neutralization – Explosive Ordnance Disposal (EOD)					✓																✓							
Submarine Mine Exercise						✓															✓		✓					
Civilian Port Defense	✓				✓		✓	✓													✓				✓		✓	

[1] SINKEX is proposed for the No Action Alternative only.

Table F-1: Components of Training Activities (continued)

Training Activity	Electromagnetic Devices	Aircraft Carriers	Surface Combatants	Amphibious Warfare Ships	Support Craft	Submarines	Towed Devices	Unmanned Surface or Underwater Vehicles	Non-Explosive Small-Caliber Projectiles	Non-Explosive Medium-Caliber Projectiles	Non-Explosive Large-Caliber Projectiles	Non-Explosive Bombs	Non-Explosive Missiles	Non-Explosive Torpedoes	Aircraft Stores or Ballast	Non-Explosive Rockets	Non-Explosive Sonobuoys	Parachutes	Chaff	Flares	High-Explosive Munitions	Targets	Seafloor Devices	Fixed-Wing Aircraft	Rotary-Wing Aircraft	Unmanned Aircraft Systems	Fiber Optic Wire	Guidance Wire
NAVAL SPECIAL WARFARE (NSW)																												
Personnel Insertion/Extraction – Submarine					✓	✓																						
Personnel Insertion/Extraction – Non-submarine					✓																			✓	✓			
OTHER TRAINING EXERCISES																												
Small Boat Attack					✓				Note 1	Note 1																		
Intelligence, Surveillance, Reconnaissance (ISR)																								✓				
Search and Rescue																									✓			
Surface Ship Sonar Maintenance			✓																									
Submarine Sonar Maintenance						✓																						

Note 1: "Blank" rounds only

F.2 COMPONENTS OF TESTING ACTIVITIES

Table F-2: Components of Testing Activities

Testing Activity	Electromagnetic Devices	Aircraft Carriers	Surface Combatants	Amphibious Warfare Ships	Support Craft	Submarines	Towed Devices	Unmanned Surface or Underwater Vehicles	Non-Explosive Small-Caliber Projectiles	Non-Explosive Medium-Caliber Projectiles	Non-Explosive Large-Caliber Projectiles	Non-Explosive Bombs	Non-Explosive Missiles	Non-Explosive Torpedoes	Aircraft Stores or Ballast	Non-Explosive Rockets	Non-Explosive Sonobuoys	Parachutes	Chaff	Flares	High-Explosive Munitions	Targets	Seafloor Devices	Fixed-Wing Aircraft	Rotary-Wing Aircraft	Unmanned Aircraft Systems	Fiber Optic Wire	Guidance Wire
Naval Sea Systems Command																												
TORPEDO TESTING																												
Torpedo Non-Explosive Testing					✓	✓		✓									✓					✓		✓				✓
AUTONOMOUS AND NON-AUTONOMOUS VEHICLES																												
Unmanned Underwater Vehicle Testing					✓		✓	✓																				
Unmanned Aircraft System								✓																		✓		
Unmanned Surface Vehicle					✓			✓																				
FLEET TRAINING/SUPPORT																												
Cold Water Training					✓																							
Post-Refit Sea Trial					✓	✓	✓																					
Anti-Submarine Warfare (ASW) Testing			✓			✓	✓										✓	✓				✓			✓			
MAINTENANCE AND MISCELLANEOUS																												
Side Scan/Multibeam Sonar					✓		✓															✓						
Non-Acoustic Tests					✓																							
ACOUSTIC COMPONENT TEST																												
Countermeasures Testing					✓	✓	✓	✓																				
Acoustic Test Facility																												
Pierside Integrated Swimmer Defense					✓																		✓					
SYSTEM, SUBSYSTEM, AND COMPONENT TESTING																												
Pierside Acoustic Testing					✓		✓	✓																				
Performance Testing At Sea					✓		✓	✓																				
Development Training and Testing					✓		✓	✓																				
PROOF-OF-CONCEPT TESTING																												
Proof-of-Concept Testing					✓		✓	✓																				

Table F-2: Components of Testing Activities (continued)

Testing Activity	Electromagnetic Devices	Aircraft Carriers	Surface Combatants	Amphibious Warfare Ships	Support Craft	Submarines	Towed Devices	Unmanned Surface or Underwater Vehicles	Non-Explosive Small-Caliber Projectiles	Non-Explosive Medium-Caliber Projectiles	Non-Explosive Large-Caliber Projectiles	Non-Explosive Bombs	Non-Explosive Missiles	Non-Explosive Torpedoes	Aircraft Stores or Ballast	Non-Explosive Rockets	Non-Explosive Sonobuoys	Parachutes	Chaff	Flares	High-Explosive Munitions	Targets	Seafloor Devices	Fixed-Wing Aircraft	Rotary-Wing Aircraft	Unmanned Aircraft Systems	Fiber Optic Wire	Guidance Wire
ACOUSTIC MEASUREMENT TESTS																												
Surface Vessel Acoustic Measurement			✓		✓																							
Underwater Vessel Acoustic Measurement					✓	✓																						
Underwater Vessel Hydrodynamic Performance Measurement					✓	✓																						
Cold Water Training					✓	✓																						
Component System Testing					✓	✓																						
Countermeasures Testing					✓	✓																						
Electromagnetic Measurement					✓	✓																						
Measurement System Repair & Replacement					✓																							
Project Operations (POPS)			✓		✓	✓																						
Target Strength Trial					✓																							
LIFE CYCLE ACTIVITIES																												
Pierside Sonar Testing																												
SHIPBOARD PROTECTION SYSTEMS AND SWIMMER DEFENSE TESTING																												
Pierside Integrated Swimmer Defense					✓																		✓					
UNMANNED VEHICLE TESTING																												
Unmanned Vehicle Development and Payload Testing					✓			✓																				
ANTI-SURFACE WARFARE (ASUW)/ANTI-SUBMARINE WARFARE (ASW) TESTING																												
Torpedo (Explosive) Testing			✓			✓		✓													✓	✓		✓	✓			✓
Torpedo (Non-explosive) Testing			✓			✓		✓									✓					✓		✓				✓
Countermeasure Testing			✓		✓		✓	✓																				
NEW SHIP CONSTRUCTION																												
Anti-Submarine Warfare (ASW) Mission Package Testing			✓					✓									✓				✓	✓	✓		✓			

Table F-2: Components of Testing Activities (continued)

Testing Activity	Electromagnetic Devices	Aircraft Carriers	Surface Combatants	Amphibious Warfare Ships	Support Craft	Submarines	Towed Devices	Unmanned Surface or Underwater Vehicles	Non-Explosive Small-Caliber Projectiles	Non-Explosive Medium-Caliber Projectiles	Non-Explosive Large-Caliber Projectiles	Non-Explosive Bombs	Non-Explosive Missiles	Non-Explosive Torpedoes	Aircraft Stores or Ballast	Non-Explosive Rockets	Non-Explosive Sonobuoys	Parachutes	Chaff	Flares	High-Explosive Munitions	Targets	Seafloor Devices	Fixed-Wing Aircraft	Rotary-Wing Aircraft	Unmanned Aircraft Systems	Fiber Optic Wire	Guidance Wire
Naval Air Systems Command																												
ANTI-SUBMARINE WARFARE (ASW)																												
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Directional Command Activated Sonobuoy System [DICASS])			✓			✓		✓									✓	✓				✓		✓				
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Multistatic Active Coherent [MAC])			✓			✓		✓									✓	✓				✓		✓				
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Sound Underwater Signal [SUS])			✓			✓											✓	✓			✓			✓				
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (Improved Extended Echo Ranging [IEER])			✓			✓		✓									✓	✓			✓	✓		✓				
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (High Duty Cycle [HDC])			✓			✓		✓									✓	✓				✓		✓				
ELECTRONIC WARFARE (EW)																												
Flare Test																				✓				✓				

F.3 STRESSORS BY TRAINING ACTIVITY

Table F-3: Stressors by Training Activity

Northwest Training Activity	Biological Resources																Physical Resources						Human Resources							
	Acoustic Stressors							Energy Stressors		Physical Stressors				Entanglement Stressors		Ingestion Stressors	Air Quality Stressors		Sediment and Water Quality Stressors											
	Tactical Acoustic Sonar	Other Acoustic Devices	Underwater Explosions	In-air Explosions	Weapons Firing Noise	Aircraft Noise	Vessel and Simulated Vessel Noise	Electromagnetic	Lasers	Aircraft and Aerial Target Strikes	Vessel and In-water Device Strikes	Military Expended Materials	Seafloor Devices	Cables and Wires	Parachutes	Military Expended Materials	Criteria Air Pollutants	Hazardous Air Pollutants	Explosives	Metals	Chemicals	Other Materials	Acoustics[1]	Physical Disturbance[1]	Accessibility[2]	Airborne Acoustics[2]	Physical Disturbance and Strikes[2]	Underwater Energy[3]	In-Air Energy[3]	Physical Interactions[3]
ANTI-AIR WARFARE (AAW)																														
Air Combat Maneuver (ACM)						✓				✓						✓	✓	✓		✓		✓	✓			✓	✓			
Missile Exercise (Air-to-Air)				✓		✓				✓		✓			✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓			✓
Gunnery Exercise (Surface-to-Air)				✓	✓	✓	✓			✓	✓	✓				✓	✓	✓	✓	✓				✓	✓	✓	✓			✓
Missile Exercise (Surface-to-Air)				✓		✓	✓			✓	✓	✓				✓	✓	✓	✓	✓	✓			✓	✓	✓	✓			✓
ANTI-SURFACE WARFARE (ASUW)																														
Gunnery Exercise (Surface-to-Surface) Ship – Small-Caliber							✓				✓	✓				✓	✓	✓		✓					✓	✓	✓			✓
Gunnery Exercise (Surface-to-Surface) Ship – Medium and Large Caliber			✓		✓		✓				✓	✓				✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓
Gunnery Exercise (Surface-to-Surface) Boat							✓				✓	✓					✓	✓						✓	✓	✓	✓			✓
Missile Exercise (Air-to-Surface)						✓				✓							✓	✓					✓	✓	✓		✓		✓	✓
Bombing Exercise (Air-to-Surface)			✓			✓				✓		✓				✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
Sinking Exercise (SINKEX)[1]			✓		✓	✓	✓			✓	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
ANTI-SUBMARINE WARFARE (ASW)																														
Tracking Exercise – Submarine	✓						✓				✓													✓			✓	✓		✓
Tracking Exercise – Surface	✓						✓				✓						✓	✓						✓	✓		✓	✓		✓
Tracking Exercise – Helicopter	✓					✓	✓			✓	✓	✓			✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓
Tracking Exercise – Maritime Patrol Aircraft	✓					✓	✓			✓	✓	✓			✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓
Tracking Exercise – Maritime Patrol (Extended Echo Ranging Sonobuoys)	✓		✓			✓				✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓

[1] SINKEX is proposed for the No Action Alternative only.

Table F-3: Stressors by Training Activity (continued)

Northwest Training Activity	Biological Resources																Physical Resources						Human Resources							
	Acoustic Stressors							Energy Stressors		Physical Stressors				Entanglement Stressors		Ingestion Stressors	Air Quality Stressors		Sediment and Water Quality Stressors											
	Tactical Acoustic Sonar	Other Acoustic Devices	Underwater Explosions	In-air Explosions	Weapons Firing Noise	Aircraft Noise	Vessel and Simulated Vessel Noise	Electromagnetic	Lasers	Aircraft and Aerial Target Strikes	Vessel and In-water Device Strikes	Military Expended Materials	Seafloor Devices	Cables and Wires	Parachutes	Military Expended Materials	Criteria Air Pollutants	Hazardous Air Pollutants	Explosives	Metals	Chemicals	Other Materials	Acoustics[1]	Physical Disturbance[1]	Accessibility[2]	Airborne Acoustics[2]	Physical Disturbance and Strikes[2]	Underwater Energy[3]	In-Air Energy[3]	Physical Interactions[3]
ELECTRONIC WARFARE (EW)																														
Electronic Warfare Operations (EW Ops)						✓	✓			✓	✓						✓	✓							✓	✓	✓			✓
MINE WARFARE (MIW)																														
Mine Neutralization – Explosive Ordnance Disposal (EOD)			✓			✓	✓			✓	✓	✓	✓			✓	✓	✓	✓				✓	✓	✓	✓	✓	✓		✓
Submarine Mine Exercise											✓	✓	✓															✓		✓
Civilian Port Defense	✓		✓			✓	✓	✓		✓	✓		✓				✓	✓	✓				✓	✓	✓	✓	✓	✓		✓
NAVAL SPECIAL WARFARE (NSW)																														
Personnel Insertion/Extraction – Submarine											✓																			
Personnel Insertion/Extraction – Non-submarine						✓				✓							✓	✓	✓							✓				
OTHER TRAINING EXERCISES																														
Small Boat Attack					✓		✓									✓	✓	✓		✓										
Intelligence, Surveillance, Reconnaissance						✓				✓							✓	✓								✓				
Search and Rescue						✓				✓							✓	✓								✓				
Surface Ship Sonar Maintenance	✓						✓				✓						✓	✓												
Submarine Sonar Maintenance	✓						✓				✓																			

[1] Cultural resources stressor
[2] Socioeconomics stressor
[3] Public health and safety stressor
Note: A check indicates events that take place for all alternatives.

F.4 STRESSORS BY TESTING ACTIVITY

Table F-4: Stressors by Testing Activity

Northwest Testing Activity	Biological Resources																Physical Resources						Human Resources							
	Acoustic Stressors							Energy Stressors		Physical Stressors				Entanglement Stressors		Ingestion Stressors	Air Quality Stressors		Sediment and Water Quality Stressors											
	Tactical Acoustic Sonar	Other Acoustic Devices	Underwater Explosions	In-air Explosions	Weapons Firing Noise	Aircraft Noise	Vessel and Simulated Vessel Noise	Electromagnetic	Lasers	Aircraft and Aerial Target Strikes	Vessel and In-water Device Strikes	Military Expended Materials	Seafloor Devices	Cables and Wires	Parachutes	Military Expended Materials	Criteria Air Pollutants	Hazardous Air Pollutants	Explosives	Metals	Chemicals	Other Materials	Acoustics[1]	Physical Disturbance[1]	Accessibility[2]	Airborne Acoustics[2]	Physical Disturbance and Strikes[2]	Underwater Energy[3]	In-Air Energy[3]	Physical Interactions[3]
Naval Sea Systems Command																														
TORPEDO TESTING																														
Torpedo Non-Explosive Testing		✓					✓				✓			✓			✓	✓		✓	✓	✓			✓		✓	✓		
AUTONOMOUS AND NON-AUTONOMOUS VEHICLES																														
Unmanned Underwater Vehicle Testing		✓					✓				✓		✓				✓	✓									✓			
Unmanned Aircraft System						✓				✓							✓	✓												
Unmanned Surface Vehicle																														
FLEET TRAINING/SUPPORT																														
Cold Water Training																														
Post-Refit Sea Trial	✓						✓				✓																			
Anti-Submarine Warfare (ASW) Testing	✓						✓				✓				✓		✓	✓												
MAINTENANCE AND MISCELLANEOUS																														
Side Scan/Multibeam Sonar		✓					✓				✓																✓			
Non-Acoustic Tests													✓																	
ACOUSTIC COMPONENT TEST																														
Countermeasures Testing		✓					✓				✓																✓			
Acoustic Test Facility																														
Pierside Integrated Swimmer Defense		✓																												

Table F-4: Stressors by Testing Activity (continued)

Northwest Testing Activity	Biological Resources																Physical Resources						Human Resources							
	Acoustic Stressors							Energy Stressors		Physical Stressors				Entanglement Stressors		Ingestion Stressors	Air Quality Stressors		Sediment and Water Quality Stressors											
	Tactical Acoustic Sonar	Other Acoustic Devices	Underwater Explosions	In-air Explosions	Weapons Firing Noise	Aircraft Noise	Vessel and Simulated Vessel Noise	Electromagnetic	Lasers	Aircraft and Aerial Target Strikes	Vessel and In-water Device Strikes	Military Expended Materials	Seafloor Devices	Cables and Wires,	Parachutes	Military Expended Materials	Criteria Air Pollutants	Hazardous Air Pollutants	Explosives	Metals	Chemicals	Other Materials	Acoustics[1]	Physical Disturbance[1]	Accessibility[2]	Airborne Acoustics[2]	Physical Disturbance and Strikes[2]	Underwater Energy[3]	In-Air Energy[3]	Physical Interactions[3]
SYSTEM, SUBSYSTEM AND COMPONENT TESTING																														
Pierside Acoustic Testing		✓					✓				✓						✓	✓												
Performance Testing At Sea		✓					✓				✓						✓	✓												
Development Training and Testing		✓					✓				✓						✓	✓												
PROOF-OF-CONCEPT TESTING																														
Proof-of-Concept Testing		✓					✓				✓						✓	✓												
ACOUSTIC MEASUREMENT TESTS																														
Surface Vessel Acoustic Measurement		✓					✓				✓																			
Underwater Vessel Acoustic Measurement		✓									✓																			
Underwater Vessel Hydrodynamic Performance Measurement		✓									✓																			
Cold Water Training		✓																												
Component System Testing		✓																												
Countermeasures Testing		✓					✓													✓	✓	✓	✓							
Electromagnetic Measurement		✓					✓				✓																			
Measurement System Repair & Replacement		✓																												
Project Operations (POPS)		✓					✓				✓																			
Target Strength Trial		✓																												
LIFE CYCLE ACTIVITIES																														
Pierside Sonar Testing	✓	✓																												
SHIPBOARD PROTECTION SYSTEMS AND SWIMMER DEFENSE TESTING																														
Pierside Integrated Swimmer Defense		✓																												

Table F-4: Stressors by Testing Activity (continued)

Northwest Testing Activity	Biological Resources																Physical Resources						Human Resources							
	Acoustic Stressors							Energy Stressors		Physical Stressors				Entanglement Stressors		Ingestion Stressors	Air Quality Stressors		Sediment and Water Quality Stressors											
	Tactical Acoustic Sonar	Other Acoustic Devices	Underwater Explosions	In-air Explosions	Weapons Firing Noise	Aircraft Noise	Vessel and Simulated Vessel Noise	Electromagnetic	Lasers	Aircraft and Aerial Target Strikes	Vessel and In-water Device Strikes	Military Expended Materials	Seafloor Devices	Cables and Wires,	Parachutes	Military Expended Materials	Criteria Air Pollutants	Hazardous Air Pollutants	Explosives	Metals	Chemicals	Other Materials	Acoustics[1]	Physical Disturbance[1]	Accessibility[2]	Airborne Acoustics[2]	Physical Disturbance and Strikes[2]	Underwater Energy[3]	In-Air Energy[3]	Physical Interactions[3]
UNMANNED VEHICLE TESTING																														
Unmanned Vehicle Development and Payload Testing		✓															✓	✓												
ANTI-SURFACE WARFARE (ASUW)/ANTI-SUBMARINE WARFARE (ASW) TESTING																														
Torpedo (Explosive) Testing		✓	✓				✓				✓			✓		✓	✓	✓	✓	✓	✓	✓			✓		✓	✓		
Torpedo (Non-explosive) Testing		✓					✓				✓			✓			✓	✓		✓	✓	✓			✓		✓	✓		
Countermeasure Testing		✓					✓				✓																✓			
NEW SHIP CONSTRUCTION																														
Anti-Submarine Warfare (ASW) Mission Package Testing	✓						✓				✓				✓		✓	✓												
Naval Air Systems Command																														
ANTI-SUBMARINE WARFARE (ASW)																														
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (DICASS)	✓					✓	✓			✓		✓			✓	✓	✓	✓		✓	✓	✓								
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (MAC)	✓					✓	✓			✓		✓			✓	✓	✓	✓		✓	✓	✓								
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (SUS)	✓					✓	✓			✓		✓			✓	✓	✓	✓		✓	✓	✓								
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (IEER)	✓		✓			✓	✓			✓		✓			✓	✓	✓	✓	✓	✓	✓	✓								
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft (HDC)	✓					✓	✓			✓		✓			✓	✓	✓	✓		✓	✓	✓								
ELECTRONIC WARFARE (EW)																														
Flare Test							✓			✓						✓	✓	✓			✓									

[1] Cultural resources stressor
[2] Socioeconomics stressor
[3] Public health and safety stressor
Notes: (1) A check indicates events that take place for all alternatives. (2) ASDS = Advanced Sea, Air, Land (SEAL) Delivery System

F.5 STRESSORS BY RESOURCE

Table F-5: Stressors by Resource

Stressors vs. Resources		Biological Resources																Physical Resources						Human Resources							
		Acoustic Stressors							Energy Stressors		Physical Stressors				Entanglement Stressors		Ingestion Stressors	Air Quality Stressors		Sediment and Water Quality Stressors				Cultural Resources Stressor		Socioeconomic Resources Stressor			Public Health and Safety Stressor		
		Tactical Acoustic Sonar	Other Acoustic Devices	Underwater Explosions	In-air Explosions	Weapons Firing Noise	Aircraft Noise	Vessel and Simulated Vessel Noise	Electromagnetic	Lasers	Aircraft and Aerial Target Strikes	Vessel and In-water Device Strikes	Military Expended Materials	Seafloor Devices	Cables and Wires	Parachutes	Military Expended Materials	Criteria Air Pollutants	Hazardous Air Pollutants	Explosives and Explosive Hyproducts	Metals	Chemicals Other than Explosives	Other Materials	Acoustics	Physical Disturbance	Accessibility	Airborne Acoustics	Physical Disturbance and Strikes	Underwater Energy	In-Air Energy	Physical Interactions
Physical	Sediments and Water Quality																			✓	✓	✓	✓								
	Air Quality																	✓	✓												
Biological	Marine Habitats			✓								✓	✓	✓																	
	Sea Turtles	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓								
	Birds	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓				✓	✓	✓												
	Marine Vegetation			✓								✓	✓	✓						✓	✓	✓	✓								
	Marine Invertebrates	✓	✓	✓					✓	✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓								
	Fish	✓	✓	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓								
Human	Cultural Resources			✓			✓						✓	✓										✓	✓						
	Native American and Alaska Native Traditional Resources			✓			✓						✓	✓										✓	✓						
	Socioeconomic Resources		✓	✓	✓	✓	✓	✓				✓	✓		✓	✓				✓	✓	✓	✓			✓	✓	✓			
	Public Health and Safety	✓	✓	✓	✓	✓					✓	✓	✓																✓	✓	✓

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Appendix G: Acoustic Primer

TABLE OF CONTENTS

APPENDIX G ACOUSTIC PRIMER G-1

G.1 TERMINOLOGY/GLOSSARY G-1
G.1.1 PARTICLE MOTION AND SOUND PRESSURE G-1
G.1.2 FREQUENCY G-1
G.1.3 DUTY CYCLE G-2
G.1.4 LOUDNESS G-2
G.2 PREDICTING HOW SOUND TRAVELS G-3
G.2.1 SOUND ATTENUATION AND TRANSMISSION LOSS G-4
G.2.1.1 Spreading Loss G-4
G.2.1.2 Reflection and Refraction G-5
G.2.1.3 Diffraction, Scattering, and Reverberation G-6
G.2.1.4 Multipath Propagation G-6
G.2.1.5 Surface and Bottom Effects G-6
G.2.1.6 Air-Water Interface G-6
G.3 SOURCES OF SOUND G-8
G.3.1 UNDERWATER SOUNDS G-10
G.3.2 PHYSICAL SOURCES OF UNDERWATER SOUND G-10
G.3.3 BIOLOGICAL SOURCES OF UNDERWATER SOUND G-10
G.3.4 ANTHROPOGENIC SOURCES OF UNDERWATER SOUND G-11
G.3.5 AERIAL SOUNDS G-11
G.3.6 NAVY SOURCES OF SOUND IN THE WATER G-11
G.4 SOUND METRICS G-12
G.4.1 PRESSURE G-12
G.4.1.1 Sound Pressure Level G-13
G.4.1.2 Sound Exposure Level G-13
G.4.2 LOUDNESS AND AUDITORY WEIGHTING FUNCTIONS G-16

LIST OF TABLES

TABLE G-1: COMMON IN-AIR SOUNDS AND THEIR APPROXIMATE DECIBEL RATINGS G-2
TABLE G-2: SOURCE LEVELS OF COMMON UNDERWATER SOUNDS G-10

LIST OF FIGURES

FIGURE G-1: GRAPHICAL REPRESENTATION OF THE INVERSE SQUARE RELATIONSHIP IN SPHERICAL SPREADING G-4
FIGURE G-2: CHARACTERISTICS OF SOUND TRANSMISSION THROUGH THE AIR-WATER INTERFACE G-7
FIGURE G-3: OCEANIC AMBIENT NOISE LEVELS FROM 1 HERTZ TO 100,000 HERTZ, INCLUDING FREQUENCY RANGES FOR PREVALENT NOISE SOURCES G-9
FIGURE G-4: EXAMPLES OF IMPULSE AND NON-IMPULSE SOUND SOURCES G-12
FIGURE G-5: VARIOUS SOUND PRESSURE METRICS FOR A HYPOTHETICAL (A) PURE TONE (NON-IMPULSE) AND (B) IMPULSE SOUND. G-13
FIGURE G-6: SUMMATION OF ACOUSTIC ENERGY (CUMULATIVE EXPOSURE LEVEL, OR SOUND EXPOSURE LEVEL) FROM A HYPOTHETICAL, INTERMITTENTLY PINGING, STATIONARY SOUND SOURCE (EL = EXPOSURE LEVEL) G-14
FIGURE G-7: CUMULATIVE SOUND EXPOSURE LEVEL UNDER REALISTIC CONDITIONS WITH A MOVING, INTERMITTENTLY PINGING SOUND SOURCE (CUMULATIVE EXPOSURE LEVEL = SOUND EXPOSURE LEVEL) G-15

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APPENDIX G ACOUSTIC PRIMER

This section introduces basic acoustic principles and terminology describing how sound travels or "propagates" in air and water. These terms and concepts are used when analyzing potential impacts due to acoustic sources and explosives used during naval training and testing. This section briefly explains the transmission of sound; introduces some of the basic mathematical formulas used to describe the transmission of sound; and defines acoustical terms, abbreviations, and units of measurement. Because seawater is a very efficient medium for the transmission of sound, the difference between transmission of sound in water and in air are discussed. Finally, it discusses the various sources of underwater sound, including physical, biological, and anthropogenic sounds.

G.1 TERMINOLOGY/GLOSSARY

Sound may be described in terms of both physical and subjective attributes. Physical attributes may be directly measured. Subjective (or sensory) attributes cannot be directly measured and require a listener to make a judgment about the sound. Physical attributes of a sound at a particular point are obtained by measuring pressure changes as sound waves pass. The following material provides a short description of some of the basic parameters of sound.

G.1.1 PARTICLE MOTION AND SOUND PRESSURE

Sound is produced when a medium (air or water in this analysis) is set into motion, often by a vibrating object within the medium. As the object vibrates, its motion is transmitted to adjacent particles of the medium. The motion of these particles is transmitted to adjacent particles, and so on. As the sound wave travels through the medium, the individual particles of the medium oscillate about their original positions but do not actually move with the sound wave. The result is a mechanical disturbance (the "sound wave") that propagates away from the source. The measurable properties of a sound are the pressure oscillations of the sound wave and the velocity, displacement amplitude, and direction of particle movements. The basic unit of sound pressure is the Pascal (Pa) (1 Pa = 1.45×10^{-4} pounds per square inch), although the most commonly encountered unit is the micropascal (µPa) (1 µPa = 1×10^{-6} Pa).

Animals with an eardrum or similar structure directly detect the pressure component of sound. Some marine fish also have specializations to detect pressure changes. Certain animals (e.g., most invertebrates and some marine fish) likely cannot detect sound pressure, only the particle motion component of sound. Because particle motion is most detectable near a sound source and at lower frequencies, this difference in acoustic energy sensing mechanisms limits the range at which these animals can detect most sound sources analyzed in this document.

G.1.2 FREQUENCY

The number of oscillations or waves per second is called the frequency of the sound, and the metric is Hertz (Hz). One Hz is equal to one oscillation per second, and 1 kilohertz (kHz) is equal to 1,000 oscillations per second. The inverse of the frequency is the period or duration of one acoustic wave.

Frequency is the physical attribute most closely associated with the subjective attribute "pitch"; the higher the frequency, the higher the pitch. Human hearing generally spans the frequency range from 20 Hz to 20 kHz. The pitch based on these frequencies is subjectively "low" (at 20 Hz) or "high" (at 20 kHz).

Pure tones have a constant, single frequency. Complex tones contain multiple, discrete frequencies, rather than a single frequency. Broadband sounds are spread across many frequencies. The frequency range of a sound is called its bandwidth. A harmonic of a sound at a particular frequency is a multiple of that frequency (e.g., harmonic frequencies of a 2 kHz tone are 4 kHz, 6 kHz, 8 kHz, etc.). A source operating at a nominal frequency may emit several harmonic frequencies at much lower sound pressure levels.

In this document, sounds are generally described as either low- (less than 1 kHz), mid- (1 kHz–10 kHz), high- (greater than 10 kHz–100 kHz), or very high- (greater than 100 kHz) frequency. Hearing ranges of marine animals (e.g., fish, birds, and marine mammals) are quite varied and are species-dependent. For example, some fish can hear sounds below 100 Hz and some species of marine mammals have hearing capabilities that extend above 100 kHz. Discussions of noise and potential impacts must therefore focus not only on the sound pressure, but the composite frequency of the noise and the species considered.

G.1.3 DUTY CYCLE

Duty cycle describes the portion of time that a sound source actually generates sound. It is defined as the percentage of the time during which a sound is generated over a total operational period. For example, if a sound navigation and ranging (sonar) source produces a 1-second ping once every 10 seconds, the duty cycle is 10 percent. Duty cycles vary among different acoustic sources; in general, a low duty cycle is 20 percent or less and a high duty cycle is 80 percent or higher.

G.1.4 LOUDNESS

Sound levels are normally expressed in decibels (dB), a commonly misunderstood term. Although the term decibel always means the same thing, decibels may be calculated in several ways, and the explanations of each can quickly become both highly technical and confusing.

Because mammalian ears can detect large pressure ranges and humans judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound pressure level is described by taking the logarithm of the ratio of the sound pressure to a reference pressure (American National Standards Institute 1994). Use of a logarithmic scale compresses the wide range of pressure values into a more usable numerical scale. (The softest audible sound has a power of about 0.000000000001 watt/square meter [m^2] and the threshold of pain is around 1 watt/m^2. With the advantage of the logarithmic scale, this ratio is efficiently described as 120 dB.)

On the decibel scale, the smallest audible sound (near total silence) is 0 dB. A sound 10 times more powerful is 10 dB. A sound 100 times more powerful than near total silence is 20 dB. A sound 1,000 times more powerful than near total silence is 30 dB. Table G-1 compares common sounds to their approximate decibel rating.

Table G-1: Common In-Air Sounds and their Approximate Decibel Ratings

Source	Source Level (dB re 20 μPa)
Near total silence	0
Whisper	15
Normal conversation	60
Lawnmower	90

Table G-1: Common In-Air Sounds and their Approximate Decibel Ratings (continued)

Source	Source Level (dB re 20 µPa)
Car horn	110
Rock concert	120
Gunshot	140

Notes: dB re 20 µPa = decibels referenced to 20 micropascals

G.2 Predicting How Sound Travels

Sounds are produced throughout a wide range of frequencies, including frequencies beyond the audible range of a given receptor. Most sounds heard in the environment do not consist of a single frequency, but rather a broad band of frequencies differing in sound level. The intensities of each frequency add to generate perceptible sound.

The speed of sound is not affected by its intensity, amplitude, or frequency, but rather depends wholly on characteristics of the medium through which it is passing. Sound generally travels faster as the density of the medium increases. Speeds of sound through air are primarily influenced by air temperature, relative humidity, and pressure, averaging about 1,115 feet per second (ft./s) (340 meters per second [m/s]) at standard barometric pressure. Sound speeds in air increase as air temperature increases. Sound travels differently in the water than in air because seawater is a very efficient medium for the transmission of sound. Sound moves at a faster speed in water, about 4,921 ft./s (1,500 m/s). The speed of sound through water is influenced by temperature, pressure, and salinity because sound travels faster as any of these parameters increase.

In the simple case of sound propagating from a point source without obstruction or reflection, the sound waves take on the shape of an expanding sphere. As spherical propagation continues, the sound energy is distributed over an ever-larger area following the inverse square law: the intensity of a sound wave decreases inversely with the square of the distance between the source and the receptor. For example, doubling the distance between the receptor and a sound source results in a reduction in the intensity of the sound of one-fourth of its initial value; tripling the distance results in one-ninth of the original intensity, and so on (Figure G-1). As expected, sound intensity drops at increasing distance from the point source. In spherical propagation, sound pressure levels drop an average of 6 dB for every doubling of distance from the source. Potential impacts on sensitive receptors, then, are directly related to the distance from the receptor to the noise source, and the intensity of the noise source itself.

While the concept of a sound wave traveling from its source to a receptor is relatively simple, sound propagation is quite complex because of the simultaneous presence of numerous sound waves of different frequencies and other phenomena such as reflections of sound waves and subsequent constructive (additive) or destructive (cancelling) interferences between reflected and incident waves. Other factors such as refraction, diffraction, bottom types, and surface conditions also affect sound propagation. While simple examples are provided here for illustration, the Navy Acoustic Effects Model used to quantify acoustic exposures to marine mammals and sea turtles takes into account the influence of multiple factors to predict acoustic propagation (Marine Species Modeling Team 2012).

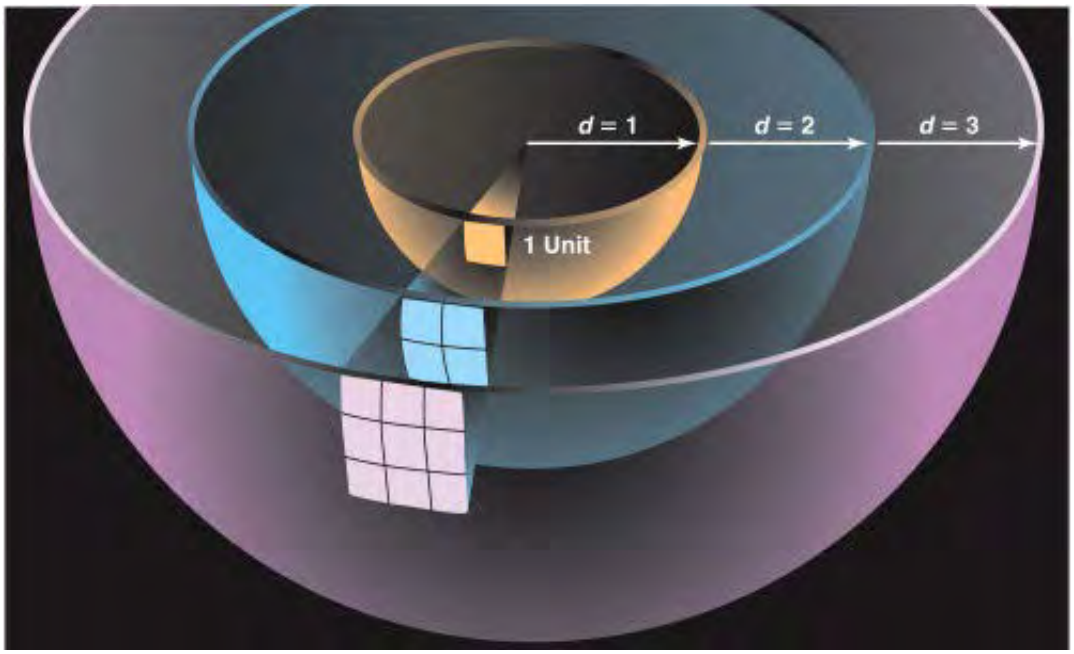


Figure G-1: Graphical Representation of the Inverse Square Relationship in Spherical Spreading

G.2.1 Sound Attenuation and Transmission Loss

As a sound wave passes through a medium, the intensity decreases with distance from the sound source. This phenomenon is known as attenuation or propagation loss. Sound attenuation may be described in terms of transmission loss (TL). The units of transmission loss are dB. The transmission loss is used to relate the source level (SL), defined as the sound pressure level produced by a sound source at a distance of 3.3 feet (ft.) (1 meter [m]), and the received level (RL) at a particular location, as follows:

$$RL = SL - TL$$

The main contributors to sound attenuation are as follows:

- Geometrical spreading of the sound wave as it propagates away from the source
- Sound absorption (conversion of sound energy into heat)
- Scattering, diffraction, multipath interference, boundary effects
- Other nongeometrical effects (Urick 1983)

G.2.1.1 Spreading Loss

Spreading loss is a geometrical effect representing regular weakening of a sound wave as it spreads out from a source (Campbell et al. 1988). Spreading describes the reduction in sound pressure caused by the increase in surface area as the distance from a sound source increases. Spherical and cylindrical spreading are common types of spreading loss.

As described before, a point sound source in a homogeneous medium without boundaries will radiate spherical waves—the acoustic energy spreads out from the source in the form of a spherical shell. As the distance from the source increases, the shell surface area increases. If the sound power is fixed, the sound intensity must decrease with distance from the source (intensity is power per unit area). The surface area of a sphere is $4\pi r^2$, where r is the sphere radius, so the change in intensity is proportional to

the radius squared. This relationship is known as the spherical spreading law. The transmission loss for spherical spreading is:

$$TL = 20\log_{10} r$$

where r is the distance from the source. This is equivalent to a 6 dB reduction in sound pressure level for each doubling of distance from the sound source. For example, calculated transmission loss for spherical spreading is 40 dB at 328.1 ft. (100 m) and 46 dB at 656.2 ft. (200 m).

In cylindrical spreading, spherical waves expanding from the source are constrained by the water surface and the seafloor and take on a cylindrical shape. In this case the sound wave expands in the shape of a cylinder rather than a sphere and the transmission loss is:

$$TL = 10\log_{10} r$$

Cylindrical spreading is an approximation to wave propagation in a water-filled channel with horizontal dimensions much larger than the depth. Cylindrical spreading predicts a 3 dB reduction in sound pressure level for each doubling of distance from the source. For example, calculated transmission loss for cylindrical spreading is 20 dB at 328.1 ft. (100 m) and 23 dB at 656.2 ft. (200 m).

G.2.1.2 Reflection and Refraction

When a sound wave propagating in a medium encounters a second medium with a different density or sound speed (e.g., the air-water boundary) part of the incident sound will be reflected back into the first medium and part will be transmitted into the second medium (Kinsler et al. 1982). If the second medium has a different sound speed than the first, the propagation direction will change as the sound wave enters the second medium; this phenomenon is called refraction. Refraction may also occur within a single medium if the sound speed varies in the medium.

Refraction of sound resulting from spatial variations in the sound speed is one of the most important phenomena that affect sound propagation in water (Urick 1983). The sound speed in the ocean primarily depends on hydrostatic pressure (i.e., depth) and temperature. Sound speed increases with both hydrostatic pressure and temperature. In seawater, temperature has the most important effect on sound speed for depths less than about 984.2 ft. (300 m). Below 4,921.3 ft. (1,500 m), the hydrostatic pressure is the dominant factor because the water temperature is relatively constant. The variation of sound speed with depth in the ocean is called a sound speed profile.

Although the actual variations in sound speed are small, the existence of sound speed gradients in the ocean has an enormous effect on the propagation of sound in the ocean. If one pictures sound as rays emanating from an underwater source, the propagation of these rays changes as a function of the sound speed profile in the water column. Specifically, the directions of the rays bend toward regions of slower sound speed. This phenomenon creates ducts in which sound becomes “trapped,” allowing it to propagate with high efficiency for large distances within certain depth boundaries. During winter months, the reduced sound speed at the surface due to cooling can create a surface duct that efficiently propagates sound such as shipping noise. The deep sound channel or Sound Frequency and Ranging channel is another duct that exists where sound speeds are lowest in the water column (1,968.5–3,937 ft. [600–1,200 m] depth at the mid-latitudes). Intense low-frequency underwater sounds, such as explosions, can be detected halfway around the world from their source via the Sound Frequency and Ranging channel (Baggeroer and Munk 1992).

G.2.1.3 Diffraction, Scattering, and Reverberation

Sound waves experience diffraction in much the same manner as light waves. Diffraction may be thought of as the bending of a sound wave around an obstacle. Common examples include sound heard from a source around the corner of a building and sound propagating through a small gap in an otherwise closed door or window. An obstacle or inhomogeneity (e.g., smoke, suspended particles, or gas bubbles) in the path of a sound wave causes scattering if secondary sound spreads out from it in a variety of directions (Pierce 1989). Scattering is similar to diffraction. Normally diffraction is used to describe sound bending or scattering from a single object, and scattering is used when there are multiple objects. Reverberation, or echo, refers to the prolongation of a sound that occurs when sound waves in an enclosed space are repeatedly reflected from the boundaries defining the space, even after the source has stopped emitting.

G.2.1.4 Multipath Propagation

In multipath propagation, sound may not only travel a direct path from a source to a receiver, but also be reflected from the surface or bottom multiple times before reaching the receiver (Urick 1983). At some distances, the reflected wave will be in phase with the direct wave (their waveforms add together) and at other distances the two waves will be out of phase (their waveforms cancel). The existence of multiple sound paths, or rays, arriving at a single point can result in multipath interference, a condition that permits the addition and cancellation between sound waves resulting in the fluctuation of sound levels over short distances. A special case of multipath propagation loss is called the Lloyd mirror effect, where the sound field near the water's surface reaches a minimum because of the destructive interference (cancellation) between the direct sound wave and the sound wave being reflected from the surface. This can cause the sound level to decrease dramatically within the top few meters of the water column.

G.2.1.5 Surface and Bottom Effects

Because the sea surface reflects and scatters sound, it has a major effect on the propagation of underwater sound in applications where either the source or receiver is at a shallow depth (Urick 1983). If the sea surface is smooth, the reflected sound pressure is nearly equal to the incident sound pressure; however, if the sea surface is rough, the amplitude of the reflected sound wave will be reduced.

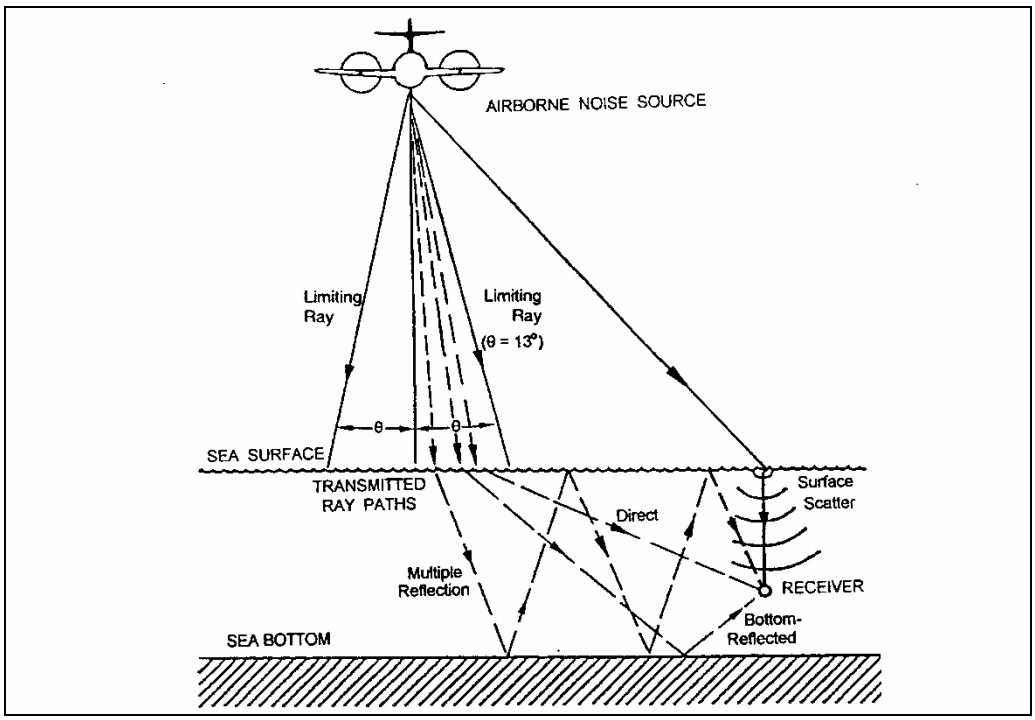
The sea bottom is also a reflecting and scattering surface, similar to the sea surface. Sound interaction with the sea bottom is more complex, however, primarily because the acoustic properties of the sea bottom are more variable and the bottom is often layered into regions of differing density and sound speed. The Lloyd mirror effect may also be observed from sound sources located near the sea bottom. For a hard bottom such as rock, the reflected wave will be approximately in phase with the incident wave. Thus, near the ocean bottom, the incident and reflected sound pressures may add together, resulting in an increased sound pressure near the sea bottom.

G.2.1.6 Air-Water Interface

Sound from aerial sources such as aircraft, muzzle blasts, and projectile sonic booms, can be transmitted into the water. The most studied of these sources are fixed-wing aircraft and helicopters, which create noise with most energy below 500 Hz. Noise levels in water are highest at the surface and are highly dependent on the altitude of the aircraft and the angle at which the aerial sound encounters the ocean surface. Transmission of the sound once it is in the water is identical to any other sound as described in the section above.

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors and has been addressed by Young (1973), Urick (1983), Richardson et al. (1995), Eller and Cavanagh (2000), Laney and Cavanagh (2000), and others. Sound is transmitted from an airborne source to a receptor underwater by four principal means: (1) a direct path, refracted upon passing through the air-water interface; (2) direct-refracted paths reflected from the bottom in shallow water; (3) evanescent transmission in which sound travels laterally close to the water surface; and (4) scattering from interface roughness due to wave motion.

Airborne sound is refracted upon transmission into water because sound waves move faster through water than through air (a ratio of about 0.23:1). Based on this difference, the direct sound path is reflected if the sound reaches the surface at an angle more than 13 degrees from vertical. As a result, most of the acoustic energy transmitted into the water from an aircraft arrives through a relatively narrow cone extending vertically downward from the aircraft (Figure G-2). The intersection of this cone with the surface traces a "footprint" directly beneath the flight path, with the width of the footprint being a function of aircraft altitude. Sound may enter the water outside of this cone due to surface scattering and as evanescent waves, which travel laterally near the water surface.



Source: Richardson et al. 1995

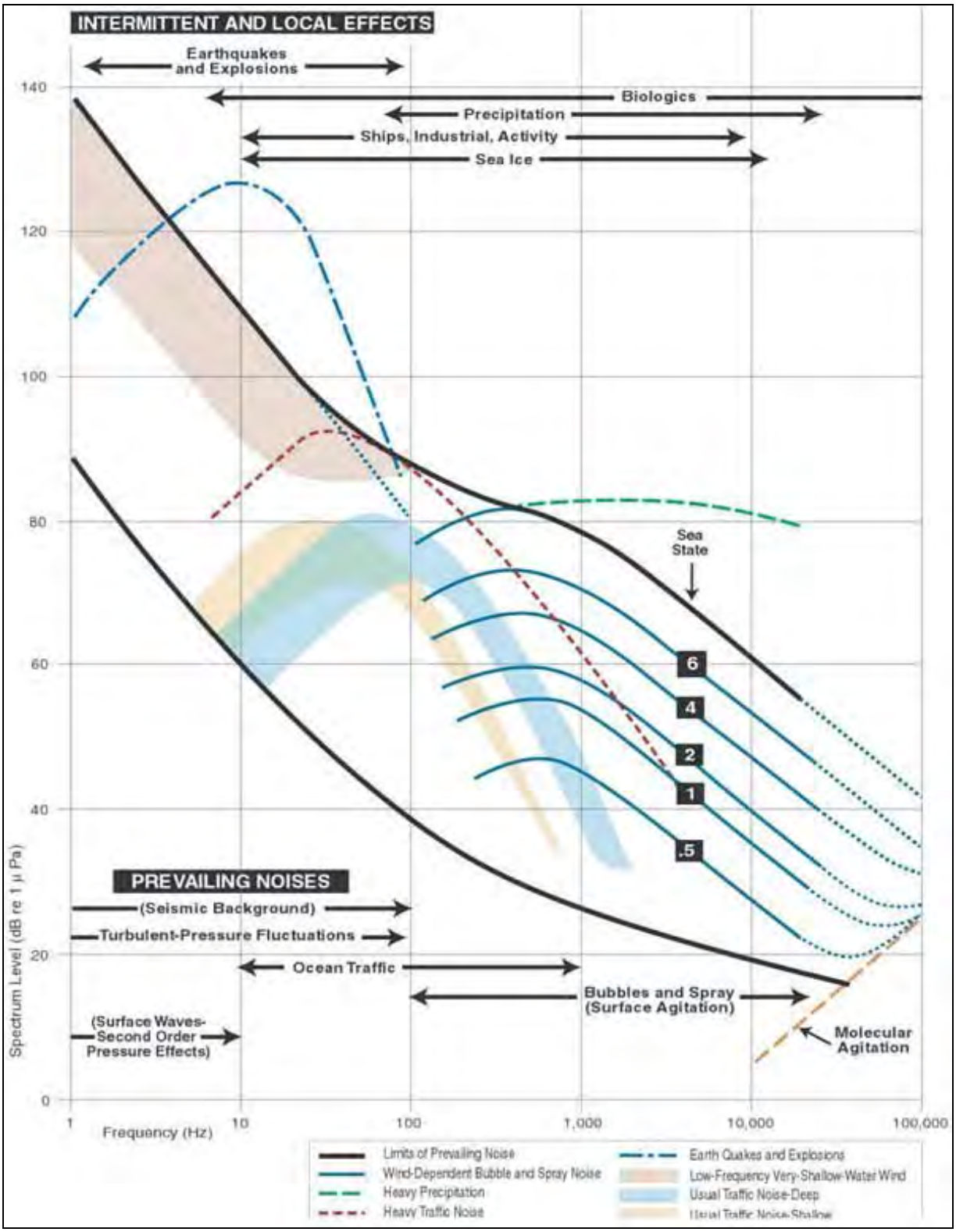
Figure G-2: Characteristics of Sound Transmission through the Air-Water Interface

The sound pressure field is actually doubled (+6 dB) at the air-to-water interface because of the large difference in the acoustic properties of water and air. For example, an airborne sound with a sound pressure level of 100 dB re 1 µPa at the sea surface becomes 106 dB re 1 µPa just below the surface. The pressure and sound levels then decrease with increasing distance as they would for any other in-water noise.

G.3 SOURCES OF SOUND

Ambient noise is the collection of ever-present sounds of both natural and human-generated origin. Ambient noise in the ocean comprises sound generated by natural physical, natural biological, and anthropogenic (human-generated) sources (Figure G-3). Preindustrial physical and biological noise sources in marine environments were often not high enough to interfere with the hearing of marine animals (Richardson et al. 1995). However, the increase in anthropogenic noise sources in recent times is a concern.

Except for sounds generated by some marine species, most natural ocean sound is broadband (composed of a spectrum of numerous frequencies). Virtually the entire frequency spectrum is represented in ambient sound sources (National Research Council 2003, adapted from Wenz 1962). Earthquakes and explosions produce sound signals from 1 Hz to 100 Hz; marine species can produce signals from 100 Hz to more than 10,000 Hz; and commercial shipping, industrial activities, and naval ships have signals between 10 Hz and 10,000 Hz (Figure G-3). Spray and bubbles associated with breaking waves are the major contributions to the ambient sound in the 50–100,000 Hz range. At frequencies greater than 100,000 Hz (or approximately 80,000 Hz in the Inland Waters of the Study Area), “thermal noise” caused by the random motion of water molecules is the primary source. Natural sources, especially from wave and tidal action, can cause coastal environments to have particularly high ambient sound levels.



Source: National Research Council (2003), adapted from Wenz (1962)

Figure G-3: Oceanic Ambient Noise Levels from 1 Hertz to 100,000 Hertz, Including Frequency Ranges for Prevalent Noise Sources

G.3.1 UNDERWATER SOUNDS

Physical, biological, and anthropogenic sounds all contribute to the ambient underwater noise environment. Example source levels for various underwater sounds are shown in Table G-2. Many naturally occurring sounds have source levels similar to anthropogenic sounds.

Table G-2: Source Levels of Common Underwater Sounds

Source	Source Level (dB re 1 µPa at 1 m)
Ice breaker ship	193[1]
Large tanker	186[1]
Seismic airgun array (32 guns)	259 (peak)[1]
Dolphin whistles	125–173[1]
Dolphin clicks	194–219[2]
Humpback whale song	144–174[3]
Snapping shrimp	183–189[4]
Sperm whale click	236[5]
Naval mid-frequency active sonar (SQS-53)	235
Lightning strike	260[6]
Seafloor volcanic eruption	255[7]

[1] Richardson et al. 1995, [2] Rasmussen et al. 2002, [3] Payne and Payne 1985; Thompson et al. 1979, [4] Au and Banks 1998, [5] Levenson 1974; Watkins 1980, [6] Hill 1985, [7] Northrop 1974

Note: dB re 1 µPa at 1 m = decibels referenced to 1 micropascal at 1 meter

G.3.2 PHYSICAL SOURCES OF UNDERWATER SOUND

Physical processes that create sound in the ocean include rain, wind, waves, sea ice, lightning strikes at the sea surface, undersea earthquakes, and eruptions from undersea volcanoes. Generally, these sound sources contribute to a rise in the ambient sound levels on an intermittent basis. Underwater sound from rain typically is between 1 and 3 kHz. Wind produces frequencies between 100 Hz and 30 kHz, while wave-generated sound is a significant contributor in the infrasonic range (i.e., 1–20 Hz) (Simmonds et al. 2003). Seismic activity results in the production of low-frequency sounds that can be heard for great distances. At short ranges, underwater sounds from earthquakes can extend to frequencies greater than 100 Hz, and the arriving signal can have a very sharp onset, similar to that of an explosion, and can last from a few seconds to a few minutes (National Research Council 2003). Energy from large man-made explosions generates the same types of T-phase waves that seismic sources do and they both can emit energy at frequencies up to 500 Hz (Richardson et al. 1995). Seismically active regions are subject to intense disturbances from strong sounds produced by earthquakes that can kill or injure marine mammals living in the region. The T-phase source signal level (10–30 Hz range) can exceed 200 dB, for a magnitude 4–5 earthquake. On 22 February 2005, a fin whale in the Gulf of California covered 13 kilometers (km) in 26 minutes (mean speed = 30.2 km/hour), in response to a 5.5 Richter scale earthquake (Gallo-Reynoso et al. 2011).

G.3.3 BIOLOGICAL SOURCES OF UNDERWATER SOUND

Marine animals use sound to navigate, communicate, locate food, reproduce, and detect predators and other important environmental cues. For example, reproductive activity, including courtship and spawning, accounts for the majority of sounds produced by fish. During the spawning season, croakers (family Sciaenidae) vocalize for many hours and often dominate the acoustic environment

(Ramcharitar et al. 2006). In addition, toothed whales and dolphins (Odontocetes) produce a wide variety of sounds including clicks, whistles, and pulsed sounds. Marine life of various types can increase ambient sound levels by nearly 20 dB over the range of a few kHz (e.g., crustaceans and fish) or over the range of tens to hundreds of kHz (e.g., dolphin clicks and whistles). For instance, bottlenose dolphin clicks and whistles have a dominant frequency range of 110–130 kHz and 3.5–14.5 kHz, respectively (Au 1993). In addition, sperm whale clicks range in frequency from 0.1–30 kHz, with dominant energy in two bands (2–4 kHz and 10–16 kHz) (Richardson et al. 1995). Blue and fin whales produce low-frequency moans at frequencies of 10–25 Hz. Colonies of snapping shrimp can generate sounds at frequencies of 2–15 kHz.

G.3.4 Anthropogenic Sources of Underwater Sound

In addition to sounds generated during Navy training and testing, other non-Navy activities also introduce similar types of anthropogenic (human-generated) sound into the ocean from a number of sources, including non-military vessel traffic, industrial operations onshore (pile driving), seismic profiling for oil exploration, oil drilling, underwater explosions, and in-air sources that can enter the water. Noise levels resulting from human activities in coastal and offshore areas are increasing; however, there are few historical records of ambient noise data to substantiate the level of increase.

Commercial shipping is the most widespread source of human-made, low-frequency (0–1,000 Hz) noise in the oceans and may contribute more than 75 percent of all human-made sound in the sea (International Council for the Exploration of the Sea 2005), particularly in coastal areas and near shipping lanes (see Figure 3.12-1 for commercial shipping lanes in the Study Area). There are approximately 20,000 large commercial vessels at sea worldwide at any given time. Because low-frequency sounds carry for long distances, a large vessel emitting sound at 6.8 Hz can be detected 75–250 nautical miles away (Polefka 2004). The dominant component of low-frequency ambient noise is commercial tankers, which contribute twice as much noise as cargo vessels and at least 100 times as much noise as research vessels (Hatch et al. 2008). Most of these sounds are produced as a result of propeller cavitation (when air spaces created by the motion of propellers collapse) (Southall et al. 2007).

High-intensity, low-frequency impulse sounds are emitted during seismic surveys to determine the structure and composition of the geological formations below the sea bed to identify potential hydrocarbon reservoirs (i.e., oil and gas exploration) (Simmonds et al. 2003).

G.3.5 Aerial Sounds

Aerial sounds may be produced by physical, biological, or anthropogenic sources. These sounds may be transmitted across the air-water interface as well. Of the physical sources of sound, surf noise is one of the most dominant. The highest sound levels from surf are typically low frequency (below 100 Hz). Biological sources of sound can be a significant contribution to the noise level in coastal environments such as areas occupied by highly vocal sea lions. Anthropogenic noise sources like ships, industrial sites, cars, and airplanes are also potential contributors.

G.3.6 Navy Sources of Sound in the Water

Many of the Navy's proposed activities may introduce sound into the ocean. The type of sound will determine how that source is measured and evaluated for potential impacts to the environment. All of the Navy-produced sounds may be categorized as impulse or non-impulse. Impulse sounds feature a very rapid increase to high pressures, followed by a rapid return to the static pressure. Impulse sounds are often produced by processes involving a rapid release of energy or mechanical impacts (Hamernik

and Hsueh 1991). Non-impulse sounds lack the rapid rise time and can have longer durations than impulse sounds. Non-impulse sound can be continuous or intermittent. See Figure G-4 for examples of impulse and non-impulse underwater sound sources.

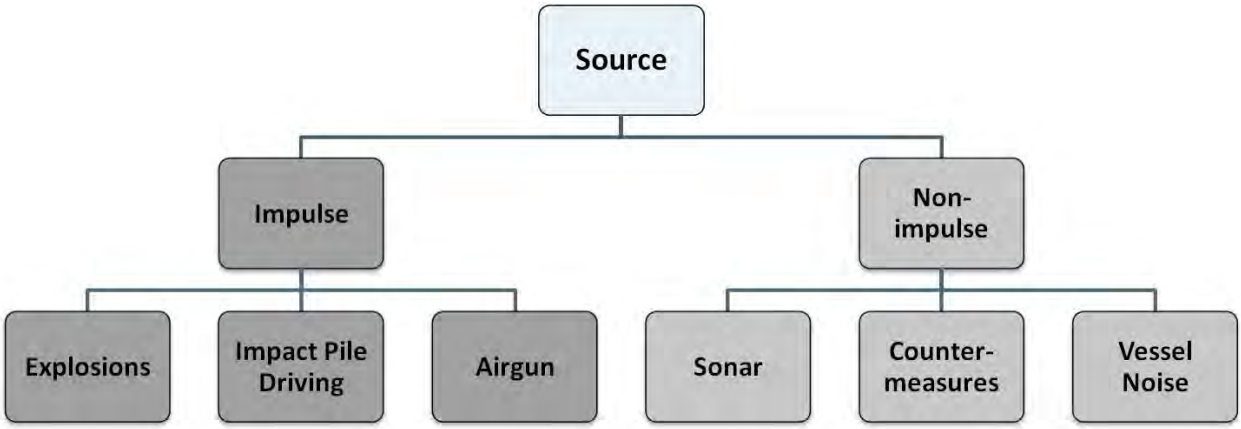


Figure G-4: Examples of Impulse and Non-impulse Sound Sources

G.4 SOUND METRICS

G.4.1 PRESSURE

Various sound pressure metrics are illustrated in Figure G-5 for (a) a non-impulse, and (b) an impulse sound. Sound pressure varies differently with time for non-impulse and impulse sounds. As shown in Figure G-5, the non-impulse sound has a relatively gradual rise in pressure from static pressure (the ambient pressure without the added sound), while the impulse sound has a near-instantaneous rise to a higher peak pressure. The peak pressure shown on both illustrations is the maximum absolute value of the instantaneous sound pressure during a specified time interval, which accounts for the values of peak pressures below the static (ambient) pressure (American National Standards Institute 1994). Peak-to-peak pressure is the difference between the maximum and minimum sound pressures. The root-mean-squared sound pressure is often used to describe the average pressure level of sounds. As the name suggests, this method takes the square root of the average squared sound pressure values over a time interval. The duration of this time interval can have a strong effect on the measured root-mean-squared sound pressure for a given sound, especially where pressure levels vary significantly, as during an impulse. If the analysis duration includes a significant portion of the waveform after the impulse has ended and the pressure has returned to near static, the root-mean-squared level would be relatively low. If the analysis duration includes the highest pressures of the impulse and excludes the portion of the waveform after the impulse has terminated, the root-mean-squared level would be comparatively high. For this reason, it is important to specify the duration used to calculate the root-mean-squared pressure for impulse sounds.

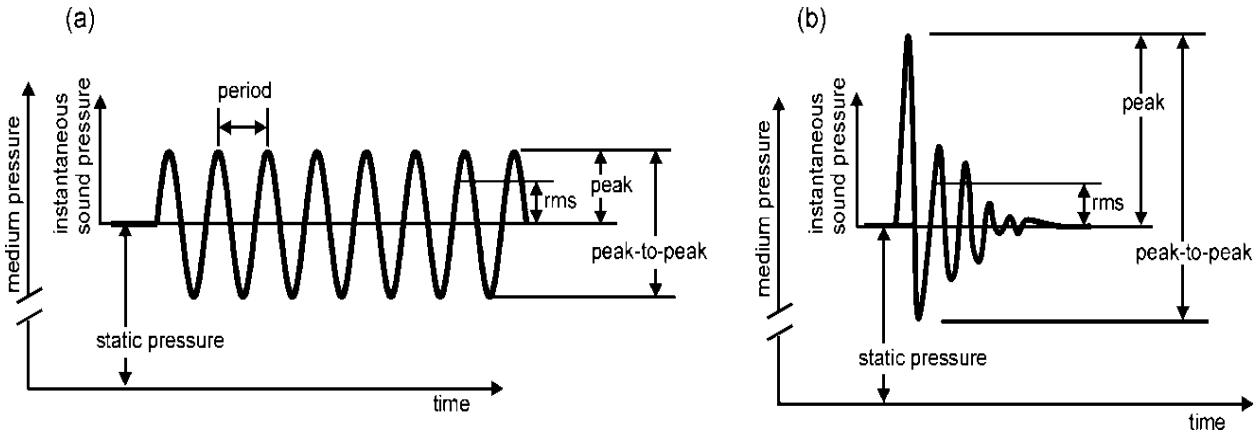


Figure G-5: Various Sound Pressure Metrics for a Hypothetical (a) Pure Tone (Non-Impulse) and (b) Impulse Sound

G.4.1.1 Sound Pressure Level

Because mammalian ears can detect large pressure ranges and humans judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound pressure level is described by taking the logarithm of the ratio of the sound pressure to a reference pressure (American National Standards Institute 1994). Use of a logarithmic scale compresses the wide range of pressure values into a more usable numerical scale.

Sound levels are normally expressed in dB. To express a pressure *X* in decibels using a reference pressure X_{ref}, the equation is:

$$20\log_{10}\left(\frac{X}{X_{ref}}\right)$$

The pressure *X* is the root-mean-square value of the pressure. When a value is presented in decibels, it is important to specify the value and units of the reference pressure. Normally the decibel value is given, followed by the text "re," meaning "with reference to," and the value and unit of the reference pressure. The standard reference pressures are 1 µPa for water and 20 µPa for air (American National Standards Institute 1994). It is important to note that, because of the difference in reference units between air and water, the same absolute pressures would result in different dB values for each medium.

G.4.1.2 Sound Exposure Level

When analyzing effects on marine animals from multiple moderate-level sounds, it is necessary to have a metric that quantifies cumulative exposure(s) (American National Standards Institute 1994). The Sound Exposure Level (SEL) can be thought of as a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., a series of sonar pings) have two main characteristics: (1) a sound level that changes throughout the event and (2) a period of time during which the source is exposed to the sound. Cumulative SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. Sound exposure level is determined by calculating the decibel level of the cumulative sum-of-squared

pressures over the duration of a sound, with units of dB re 1 micropascal squared seconds (μPa^2-s) for sounds in water.

Some rules of thumb for SEL are as follows:

- The numeric value of SEL is equal to the sound pressure level of a 1-second sound that has the same total energy as the exposure event. If the sound duration is 1 second, sound pressure level and SEL have the same numeric value (but not the same reference quantities). For example, a 1-second sound with a sound pressure level of 100 dB re 1 µPa has a SEL of 100 dB re 1 μPa^2-s.
- If the sound duration is constant but the sound pressure level changes, SEL will change by the same number of decibels as the sound pressure level.
- If the sound pressure level is held constant and the duration (*T*) changes, SEL will change as a function of $10\log_{10}(T)$:
    - $10\log_{10}(10) = 10$, so increasing duration by a factor of 10 raises SEL by 10 dB.
    - $10\log_{10}(0.1) = -10$, so decreasing duration by a factor of 10 lowers SEL by 10 dB.
    - Since $10\log_{10}(2) \approx 3$, so doubling the duration increases SEL by 3 dB.
    - $10\log_{10}(1/2) \approx -3$, so halving the duration lowers SEL by 3 dB.

Figure G-6 illustrates the summation of energy for a succession of sonar pings. In this hypothetical case, each ping has the same duration and sound pressure level. The SEL at a particular location from each individual ping is 100 dB re 1 μPa^2-s (red circles). The upper, blue curve shows the running total or cumulative SEL.

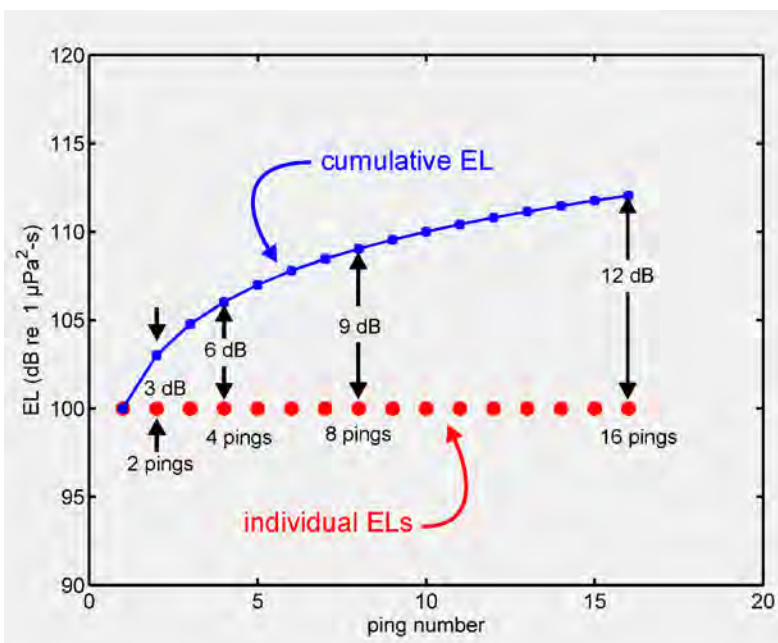


Figure G-6: Summation of Acoustic Energy (Cumulative Exposure Level, or Sound Exposure Level) from a Hypothetical, Intermittently Pinging, Stationary Sound Source (EL = Exposure Level)

After the first ping, the cumulative SEL is 100 dB re 1 μPa^2-s. Since each ping has the same duration and sound pressure level, receiving two pings is the same as receiving a single ping with twice the duration. The cumulative SEL from two pings is therefore 103 dB re 1 μPa^2-s. The cumulative SEL from four pings is

3 dB higher than the cumulative SEL from two pings, or 106 dB re 1 μPa^2-s. Each doubling of the number of pings increases the cumulative SEL by 3 dB.

Figure G-7 shows a more realistic example where the individual pings do not have the same sound pressure level or SEL. These data were recorded from a stationary hydrophone as a sound source approached, passed, and moved away from the hydrophone. As the source approached the hydrophone, the received sound pressure level from each ping increased, causing the SEL of each ping to increase. After the source passed the hydrophone, the received sound pressure level and SEL from each ping decreased as the source moved farther away (downward trend of red line), although the cumulative SEL increased with each additional ping received (slight upward trend of blue line). The main contributions are from those pings with the highest individual SELs. Individual pings with SELs 10 dB or more below the ping with the highest level contribute little (less than 0.5 dB) to the total cumulative SEL. This is shown in Figure G-7 where only a small error is introduced by summing the energy from the eight individual pings with SEL greater than 185 dB re 1 μPa^2-s (black line), as opposed to including all pings (blue line).

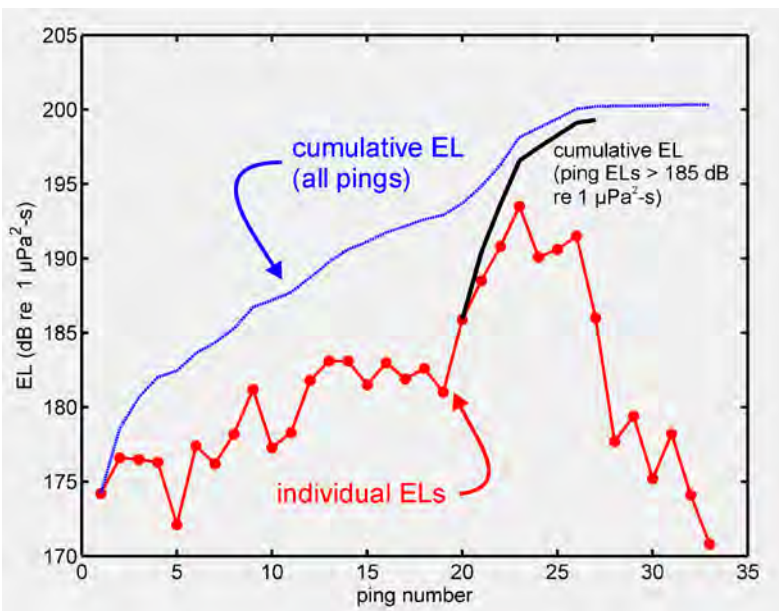


Figure G-7: Cumulative Sound Exposure Level under Realistic Conditions with a Moving, Intermittently Pinging Sound Source (Cumulative Exposure Level = Sound Exposure Level)

Impulse (Pascal-seconds)

Impulse is a metric used to describe the pressure and time component of an intense shock wave from an explosive source. The impulse calculation takes into account the magnitude and duration of the initial peak positive pressure, which is the portion of an impulse sound most likely to be associated with damage. Specifically, impulse is the time integral of the initial peak positive pressure with units of Pascal-seconds. The peak positive pressure for an impulse sound is shown in Figure G-5 as the first and largest pressure peak above static pressure. This metric is used to assess potential injurious effects from explosives.

G.4.2 LOUDNESS AND AUDITORY WEIGHTING FUNCTIONS

Animals, including humans, are not equally sensitive to sounds across their entire hearing range. The subjective judgment of a sound level by a receiver such as an animal is known as loudness. Two sounds received at the same sound pressure level (an objective measurement), but at two different frequencies, may be perceived by an animal at two different loudness levels depending on its hearing sensitivity (lowest sound pressure level at which a sound is first audible) at the two different frequencies. Furthermore, two different species may judge the relative loudness of the two sounds differently.

Auditory weighting functions are a method common in human hearing risk analysis to account for differences in hearing sensitivity at various frequencies. This concept can be applied to other species as well. When used in analyzing the impacts of sound on an animal, auditory weighting functions adjust received sound levels to emphasize ranges of best hearing and de-emphasize ranges of less or no sensitivity. A-weighted sound levels, often seen in units of “dBA” (A-weighted decibels), are frequency-weighted to account for the sensitivity of the human ear to a barely audible sound. Many measurements of sound in air appear as A-weighted decibels in the literature because the intent of the authors is often to assess noise impacts on humans.

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Appendix H: Biological Resource Methods

TABLE OF CONTENTS

APPENDIX H BIOLOGICAL RESOURCE METHODS H-1

H.1 CONCEPTUAL FRAMEWORK FOR ASSESSING EFFECTS FROM SOUND-PRODUCING ACTIVITIES H-1
H.1.1 FLOWCHART H-2
H.1.2 STIMULI H-5
H.1.3 PHYSIOLOGICAL RESPONSES H-5
H.1.3.1 Trauma H-5
H.1.3.2 Auditory Fatigue H-7
H.1.3.3 Auditory and Communication Masking H-8
H.1.3.4 Physiological Stress H-8
H.1.4 BEHAVIORAL RESPONSES H-9
H.1.4.1 Trauma and Auditory Fatigue H-9
H.1.4.2 Auditory Masking H-10
H.1.4.3 Behavioral Reactions and Physiological Stress H-10
H.1.5 COSTS TO THE ANIMAL H-12
H.1.5.1 Trauma H-12
H.1.5.2 Auditory Fatigue and Auditory Masking H-12
H.1.5.3 Behavioral Reactions and Physiological Stress H-13
H.1.6 RECOVERY H-14
H.1.7 LONG-TERM CONSEQUENCES TO THE INDIVIDUAL AND THE POPULATION H-15
H.2 CONCEPTUAL FRAMEWORK FOR ASSESSING EFFECTS FROM ENERGY-PRODUCING ACTIVITIES H-16
H.2.1 STIMULI H-16
H.2.1.1 Magnitude of the Energy Stressor H-16
H.2.1.2 Location of the Energy Stressor H-17
H.2.1.3 Behavior of the Organism H-17
H.2.2 IMMEDIATE RESPONSE AND COSTS TO THE INDIVIDUAL H-17
H.2.3 LONG-TERM CONSEQUENCES TO THE INDIVIDUAL AND POPULATION H-17
H.3 CONCEPTUAL FRAMEWORK FOR ASSESSING EFFECTS FROM PHYSICAL DISTURBANCE OR STRIKE H-18
H.3.1 STIMULI H-18
H.3.1.1 Size and Weight of the Objects H-18
H.3.1.2 Location and Speed of the Objects H-18
H.3.1.3 Buoyancy of the Objects H-18
H.3.1.4 Behavior of the Organism H-18
H.3.2 IMMEDIATE RESPONSE AND COSTS TO THE INDIVIDUAL H-18
H.3.3 LONG-TERM CONSEQUENCES TO THE POPULATION H-19
H.4 CONCEPTUAL FRAMEWORK FOR ASSESSING EFFECTS FROM ENTANGLEMENT H-19
H.4.1 STIMULI H-19
H.4.1.1 Physical Properties of the Objects H-19
H.4.1.2 Location of the Objects H-19
H.4.1.3 Buoyancy of Objects H-19
H.4.1.4 Behavior of the Organism H-20
H.4.2 IMMEDIATE RESPONSE AND COSTS TO THE INDIVIDUAL H-20
H.4.3 LONG-TERM CONSEQUENCES TO THE INDIVIDUAL AND POPULATION H-20
H.5 CONCEPTUAL FRAMEWORK FOR ASSESSING EFFECTS FROM INGESTION H-20
H.5.1 STIMULI H-20

H.5.1.1 Size of the Objects H-20
H.5.1.2 Location of the Objects H-20
H.5.1.3 Buoyancy of the Objects H-21
H.5.1.4 Feeding Behavior H-21
H.5.2 IMMEDIATE RESPONSE AND COSTS TO THE INDIVIDUAL H-21
H.5.3 LONG-TERM CONSEQUENCES TO THE INDIVIDUAL AND POPULATION H-21

LIST OF TABLES

There are no tables in this section.

LIST OF FIGURES

FIGURE H-1: FLOW CHART OF THE EVALUATION PROCESS OF SOUND-PRODUCING ACTIVITIES H-3
FIGURE H-2: TWO HYPOTHETICAL THRESHOLD SHIFTS H-7

APPENDIX H BIOLOGICAL RESOURCE METHODS

The analysis of impacts on biological resources focused on the likelihood of encountering the stressor, the primary stimulus, response, and recovery of individual organisms. Where appropriate, the differential potential of biological resources to overlap with stressors was considered at the level of specific geographic areas (large marine ecosystems, open ocean areas, range complexes, operating areas, and other training and testing areas). Additionally, the differential impacts of training versus testing activities that introduce stressors to the resource were considered.

H.1 CONCEPTUAL FRAMEWORK FOR ASSESSING EFFECTS FROM SOUND-PRODUCING ACTIVITIES

This conceptual framework describes the different types of effects that are possible and the potential relationships between sound stimuli and long-term consequences for the individual and population. The conceptual framework is central to the assessment of acoustic-related effects and is consulted multiple times throughout the process. It describes potential effects and the pathways by which an acoustic stimulus or sound-producing activity can potentially affect animals. The conceptual framework qualitatively describes costs to the animal (e.g., expended energy or missed feeding opportunity) that may be associated with specific reactions. Finally, the conceptual framework outlines the conditions that may lead to long-term consequences for the individual and population if the animal cannot fully recover from the short-term effects. Within each biological resource section (e.g., marine mammals, birds, and fish), the detailed methods to predict effects to specific taxa are derived from this conceptual framework.

An animal is considered “exposed” to a sound if the received sound level at the animal’s location is above the background ambient noise level within a similar frequency band. A variety of effects may result from exposure to sound-producing activities. The severity of these effects can vary greatly between minor effects that have no real cost to the animal, to more severe effects that may have lasting consequences. Whether a marine animal is significantly affected must be determined from the best available scientific data regarding the potential physiological and behavioral responses to sound-producing activities and the possible costs and long-term consequences of those responses.

The major categories of potential effects are:

- Direct trauma
- Auditory fatigue
- Auditory masking
- Behavioral reactions
- Physiological stress

Direct trauma refers to injury to organs or tissues of an animal as a direct result of an intense sound wave or shock wave impinging upon or passing through its body. Potential impacts on an animal’s internal tissues and organs are assessed by considering the characteristics of the exposure and the response characteristics of the tissues. Trauma can be mild and fully recoverable, with no long-term repercussions to the individual or population, or more severe, with the potential for lasting effects or, in some cases, mortality.

Auditory fatigue may result from over-stimulation of the delicate hair cells and tissues within the auditory system. The most familiar effect of auditory fatigue is hearing loss, also called a noise-induced threshold shift, meaning an increase in the hearing threshold.

Audible natural and artificial sounds can potentially result in auditory masking, a condition that occurs when noise interferes with an animal's ability to hear other sounds and may affect the animal's ability to communicate, such as requiring the animal to adjust the frequency or loudness of its call. Masking occurs when the perception of a sound is interfered with by a second sound, and the probability of masking increases as the two sounds increase in similarity and the masking sound increases in level. It is important to distinguish auditory fatigue, which persists after the sound exposure, from masking, which occurs only during the sound exposure.

Marine animals naturally experience physiological stress as part of their normal life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with conspecifics (members of the same species), and interactions with predators all contribute to the stress a marine animal naturally experiences. The physiological response to a stressor, often termed the stress response, is an adaptive process that helps an animal cope with changing external and internal environmental conditions. However, too much of a stress response can be harmful to an animal, resulting in physiological dysfunction. In some cases, naturally occurring stressors can have profound impacts on animals. Sound-producing activities have the potential to provide additional stress, which must be considered, not only for its direct impact on an animal's behavior but also for contributing to an animal's chronic stress level.

A sound-producing activity can cause a variety of behavioral reactions in animals ranging from very minor and brief, to more severe reactions such as aggression or prolonged flight. The acoustic stimuli can cause a stress reaction (e.g., startle or annoyance); they may act as a cue to an animal that has experienced a stress reaction in the past to similar sounds or activities, or that acquired a learned behavioral response to the sounds from conspecifics. An animal may choose to deal with these stimuli or ignore them based on the severity of the stress response, the animal's past experience with the sound, as well as other stimuli present in the environment. If an animal chooses to react to the acoustic stimuli, then the behavioral responses fall into two categories: alteration of an ongoing behavior pattern or avoidance. The specific type and severity of these reactions helps determine the costs and ultimate consequences to the individual and population.

H.1.1 FLOWCHART

Figure H-1 is a flowchart that diagrams the process used to evaluate the potential effects on marine animals from sound-producing activities. The shape and color of each box on the flowchart represent either a decision point in the analysis (green diamonds); specific processes such as responses, costs, or recovery (blue rectangles); external factors to consider (purple parallelograms); and final outcomes for the individual or population (orange ovals and rectangles). Each box is labeled for reference throughout the following sections. For simplicity, *sound* is used here to include not only acoustic waves but also shock waves generated from explosive sources. The supporting text clarifies those instances where it is necessary to distinguish between the two phenomena.

Box A1, the *Sound-Producing Activity*, is the source of the sound stimuli and therefore the starting point in the analysis. Each of the five major categories of potential effects (i.e., direct trauma, auditory fatigue, masking, behavioral response, and stress) are presented as pathways that flow from left to right across the diagram. Pathways are not exclusive, and each must be followed until it can be concluded that an

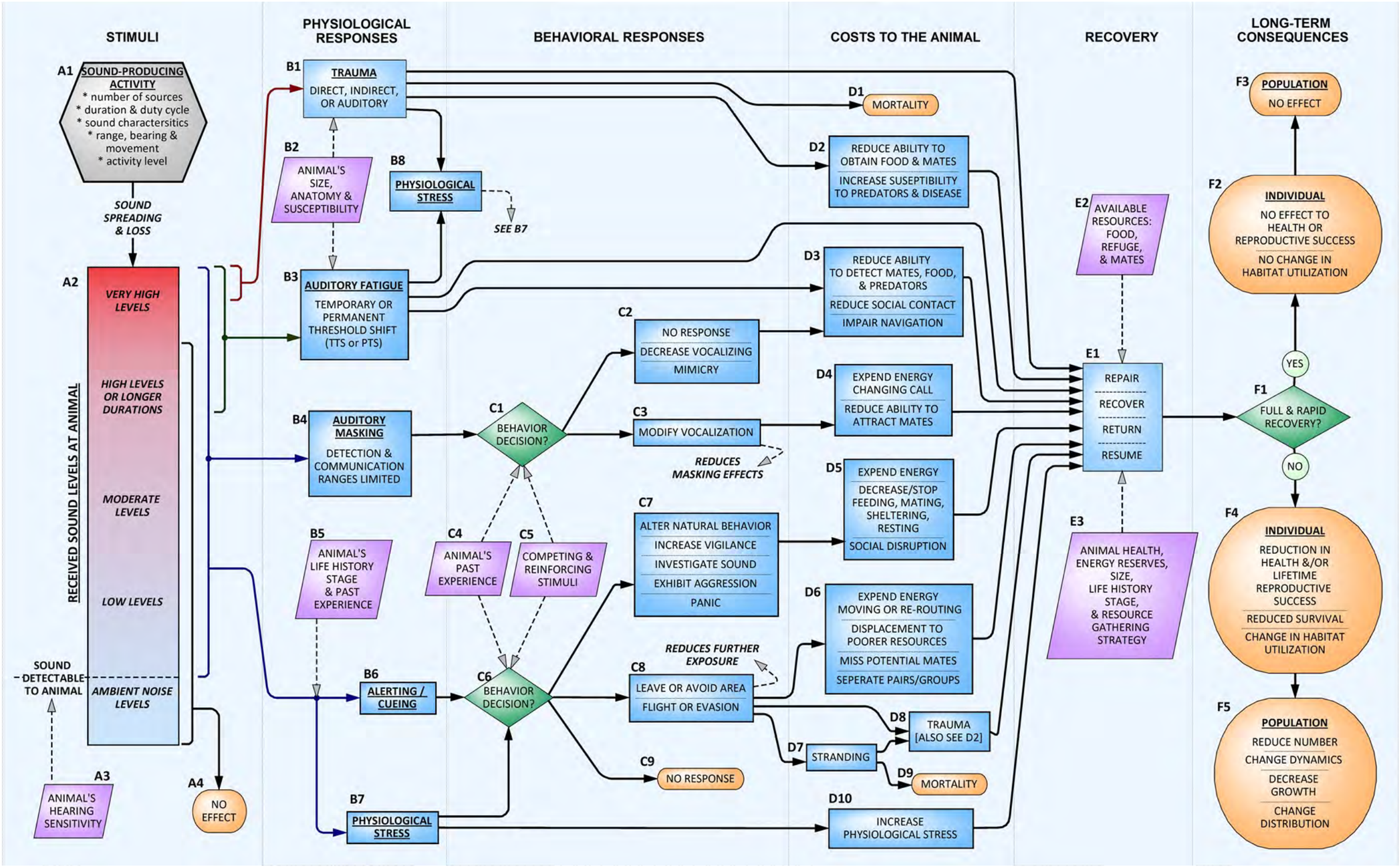

Figure H-1: Flow Chart of the Evaluation Process of Sound-Producing Activities

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animal is not at risk for that specific effect. The vertical columns show the steps in the analysis used to examine each of the effects pathways. These steps proceed from the Stimuli, to the Physiological Responses, to any potential Behavioral Responses, to the Costs to the Animal, to the Recovery of the animal, and finally to the Long-Term Consequences for the Individual and Population.

H.1.2 STIMULI

The first step in predicting whether a sound-producing activity is capable of causing an effect on a marine animal is to define the *Stimuli* experienced by the animal. The *Stimuli* include the *sound-producing activity*, the surrounding acoustical environment, and the characteristics of the sound when it reaches the animal, and whether the animal can detect the sound.

Sounds emitted from a *sound-producing activity* (Box A1) travel through the environment to create a spatially variable sound field. There can be any number of individual sound sources in a given activity, each with its own unique characteristics. For example, a Navy training exercise may involve several ships and aircraft, several types of sonar, and several types of ordnance. Each of the individual sound sources has unique characteristics: source level, frequency, duty cycle, duration, and rise-time (i.e., impulse vs. non-impulse). Each source also has a range, depth/altitude, bearing and directionality, and movement relative to the animal.

Environmental factors such as temperature, salinity, bathymetry, bottom type, and sea state all impact how sound spreads through the environment and how sound decreases in amplitude between the source and the receiver (individual animal). Mathematical calculations and computer models are used to predict how the characteristics of the sound will change between the source and the animal under a range of realistic environmental conditions for the locations where sound-producing activities occur.

The details of the overall activity may also be important to place the potential effects into context and help predict the range of severity of the probable reactions. The overall activity level (e.g., number of ships and aircraft involved in exercise); the number of sound sources within the activity; the activity duration; and the range, bearing, and movement of the activity relative to the animal are all considered.

The *received sound at the animal* and the number of times the sound is experienced (i.e., repetitive exposures) (Box A2) determines the range of possible effects. Sounds that are higher than the ambient noise level and within an *animal's hearing sensitivity* range (Box A3) have the potential to cause effects. Very high exposure levels may have the potential to cause trauma; high-level exposures, long-duration exposures, or repetitive exposures may potentially cause auditory fatigue; lower-level exposures may potentially lead to masking; all perceived levels may lead to stress; and many sounds, including sounds that are not detectable by the animal, would have *no* e*ffect* (Box A4).

H.1.3 PHYSIOLOGICAL RESPONSES

Physiological Responses include direct trauma, hearing loss, auditory masking, and stress. The magnitude of the involuntary response is predicted based on the characteristics of the acoustic stimuli and the characteristics of the animal (species, susceptibility, life history stage, size, and past experiences).

H.1.3.1 Trauma

Physiological responses to sound stimulation may range from mechanical vibration (with no resulting adverse effects) to tissue trauma (injury). Direct *trauma* (Box B1) refers to the direct injury of tissues and

organs by sound waves impinging upon or traveling through an animal's body. Marine animals' bodies, especially their auditory systems, are well adapted to large hydrostatic pressures and large, but relatively slow, pressure changes that occur with changing depth. However, mechanical trauma may result from exposure to very-high-amplitude sounds when the elastic limits of the auditory system are exceeded or when animals are exposed to intense sounds with very rapid rise times, such that the tissues cannot respond adequately to the rapid pressure changes. Trauma to marine animals from sound exposure requires high received levels. Trauma effects therefore normally only occur with very-high-amplitude, often impulse, sources, and at relatively close range, which limits the number of animals likely exposed to trauma-inducing sound levels.

Direct trauma includes both auditory and non-auditory trauma. Auditory trauma is the direct mechanical injury to hearing-related structures, including tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the organ of Corti and the associated hair cells. Auditory trauma differs from auditory fatigue in that the latter involves the overstimulation of the auditory system at levels below those capable of causing direct mechanical damage. Auditory trauma is always injurious but can be temporary. One of the most common consequences of auditory trauma is hearing loss (see below).

Non-auditory trauma can include hemorrhaging of small blood vessels and the rupture of gas-containing tissues such as the lung, swim bladder, or gastrointestinal tract. After the ear (or other sound-sensing organs), these are usually the most sensitive organs and tissues to acoustic trauma. An *animal's size and anatomy* are important in determining its *susceptibility to trauma* (Box B2), especially non-auditory trauma. Larger size indicates more tissue to protect vital organs that might be otherwise susceptible (i.e., there is more attenuation of the received sound before it impacts non-auditory structures). Therefore, larger animals should be less susceptible to trauma than smaller animals. In some cases, acoustic resonance of a structure may enhance the vibrations resulting from noise exposure and result in an increased susceptibility to trauma. Resonance is a phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration, or the particular frequency at which the object vibrates most readily. The size, geometry, and material composition of a structure determine the frequency at which the object will resonate. The potential for resonance is determined by comparing the sound frequencies with the resonant frequency and damping of the tissues. Because most biological tissues are heavily damped, the increase in susceptibility from resonance is limited.

Vascular and tissue bubble formation resulting from sound exposure is a hypothesized mechanism of indirect trauma to marine animals. The risk of bubble formation from one of these processes, called rectified diffusion, is based on the amplitude, frequency, and duration of the sound (Crum and Mao 1996) and an animal's tissue nitrogen gas saturation at the time of the exposure. Rectified diffusion is the growth of a bubble that fluctuates in size because of the changing pressure field caused by the sound wave. An alternative, but related hypothesis, has also been suggested: stable microbubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of gas-supersaturated tissues. Bubbles have also been hypothesized to result from changes in the dive behavior of marine mammals as a result of sound exposure (Jepson et al. 2003). Vascular bubbles produced by this mechanism would not be a physiological response to the sound exposure, but a cost to the animal because of the change in behavior (Section H.1.5, Costs to the Animal). Under either of these hypotheses, several things could happen: (1) bubbles could grow to the extent that vascular blockage (emboli) and tissue hemorrhage occur, (2) bubbles could develop to the extent that a complement immune response is triggered or the nervous tissue is subjected to enough localized pressure that pain or dysfunction occurs, or (3) the bubbles could be cleared by the lung

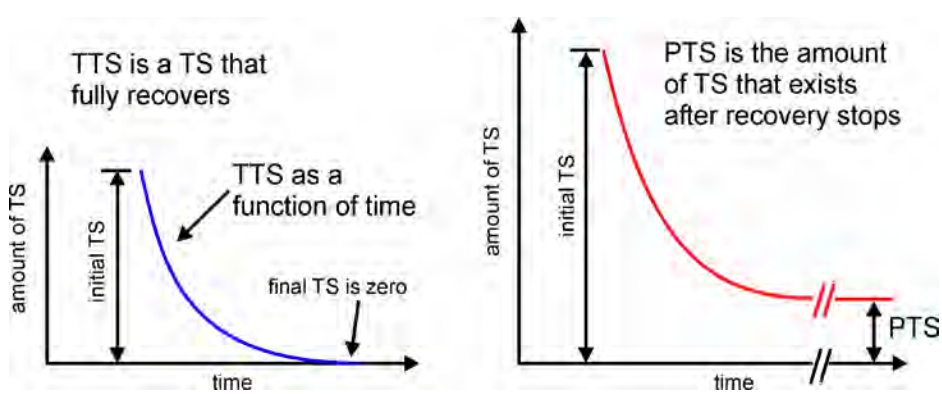
without negative consequence to the animal. Although rectified diffusion is a known phenomenon, its applicability to diving marine animals exposed to sound is questionable; animals would need to be highly supersaturated with gas and very close to a high-level sound source (Crum et al. 2005). The other two hypothesized phenomena are largely theoretical and have not been demonstrated under realistic exposure conditions.

H.1.3.2 Auditory Fatigue

Auditory fatigue is a reduction in hearing ability resulting from overstimulation to sounds. The mechanisms responsible for auditory fatigue differ from auditory trauma and may consist of a variety of mechanical and biochemical processes, including physical damage or distortion of the tympanic membrane and cochlear hair cell stereocilia, oxidative stress-related hair cell death, changes in cochlear blood flow, and swelling of cochlear nerve terminals resulting from glutamate excitotoxicity (Henderson et al. 2006; Kujawa and Liberman 2009). Although the outer hair cells are the most prominent target for fatigue effects, severe noise exposures may also result in inner hair cell death and loss of auditory nerve fibers (Henderson et al. 2006). Auditory fatigue is possibly the best studied type of effect from sound exposures in marine and terrestrial animals, including humans. The characteristics of the received sound stimuli are used and compared to the *animal's hearing sensitivity* and susceptibility to noise (Box A3) to determine the potential for auditory fatigue.

Auditory fatigue manifests itself as hearing loss, called a noise-induced threshold shift. A threshold shift may be either permanent threshold shift (PTS) or temporary threshold shift (TTS). Note that the term "auditory fatigue" is often used to mean a TTS; however, in this analysis, a more general meaning to differentiate fatigue mechanisms (e.g., metabolic exhaustion and distortion of tissues) from auditory trauma mechanisms (e.g., physical destruction of cochlear tissues occurring at the time of exposure) is used.

The distinction between PTS and TTS is based on whether there is a complete recovery of hearing sensitivity following a sound exposure. If the threshold shift eventually returns to zero (the animal's hearing returns to pre-exposure value), the threshold shift is a TTS. If the threshold shift does not return to zero but leaves some finite amount of threshold shift, then that remaining threshold shift is a PTS. Figure H-2 shows one hypothetical threshold shift that completely recovers, a TTS, and one that does not completely recover, leaving some PTS.



Notes: TTS = temporary threshold shift, TS = threshold shift, PTS = permanent threshold shift

Figure H-2: Two Hypothetical Threshold Shifts

The relationship between TTS and PTS is complicated and poorly understood, even in humans and terrestrial mammals, where numerous studies failed to delineate a clear relationship between the two. Relatively small amounts of TTS (e.g., less than 40–50 decibels (dB) measured 2 minutes after exposure) will recover with no apparent long-term effects; however, terrestrial mammal studies revealed that large amounts of TTS (e.g., approximately 40 dB measured 24 hours after exposure) can result in permanent neural degeneration, despite the hearing thresholds returning to normal (Kujawa and Liberman 2009). The amounts of TTS induced by Kujawa and Liberman were described as being "at the limits of reversibility." It is unknown whether smaller amounts of TTS can result in similar neural degeneration, or if effects would translate to other species such as marine animals.

The amplitude, frequency, duration, and temporal pattern of the sound exposure are important parameters for predicting the potential for auditory fatigue. Duration is particularly important because auditory fatigue is exacerbated with prolonged exposure time. The frequency of the sound also plays an important role in susceptibility to hearing loss. Experiments show that animals are most susceptible to *fatigue* (Box B3) within their most sensitive hearing range. Sounds outside of an animal's audible frequency range do not cause fatigue.

The greater the degree of threshold shift, the smaller the ocean space within which an animal can detect biologically relevant sounds and communicate. This is referred to as reducing an animal's "acoustic space." This reduction can be estimated given the amount of threshold shift incurred by an animal.

H.1.3.3 Auditory and Communication Masking

Auditory masking occurs if the noise from an activity interferes with an animal's ability to detect, understand, elicit, or recognize biologically relevant sounds of interest (Box B4). "Noise" refers to unwanted or unimportant sounds that mask an animal's ability to hear "sounds of interest" and affect an animal's ability to generate sounds (or call). A sound of interest refers to a sound that is potentially being detected. Sounds of interest include echolocation clicks; sounds from predators; natural, abiotic sounds that may aid in navigation; and reverberation, which can give an animal information about its location and orientation within the ocean. Sounds of interest are frequently generated by conspecifics such as offspring, mates, and competitors.

The frequency, received level, and duty cycle of the sound determine the potential degree of auditory masking. Similar to hearing loss, the greater the degree of masking, the smaller the ocean space within which an animal can detect biologically relevant sounds.

H.1.3.4 Physiological Stress

If a sound is detected (i.e., heard or sensed) by an animal, a *stress* response can occur (Box B7); or the sound can *cue or alert* the animal (Box B6) without a direct, measurable stress response. If an animal suffers trauma or auditory fatigue, a *physiological stress* response will occur (Box B8). A stress response is a physiological change resulting from a stressor that is meant to help the animal deal with the stressor. The generalized stress response is characterized by a release of hormones (Reeder and Kramer 2005); however, it is now acknowledged that other chemicals produced in a stress response (e.g., stress markers) exist. For example, a release of reactive oxidative compounds, as occurs in noise-induced hearing loss (Henderson et al. 2006), occurs in response to some acoustic stressors. Stress hormones include those produced by the sympathetic nervous system, norepinephrine and epinephrine (i.e., the catecholamines), which produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipid for energy. Other stress hormones are the glucocorticoid steroid hormones cortisol and aldosterone, which are produced by the adrenal gland. These hormones

are classically used as an indicator of a stress response and to characterize the magnitude of the stress response (Hennessy et al. 1979). Oxidative stress occurs when reactive molecules, called reactive oxygen species, are produced in excess of molecules that counteract their activity (i.e., antioxidants).

An acute stress response is traditionally considered part of the startle response and is hormonally characterized by the release of the catecholamines. Annoyance type reactions may be characterized by the release of either or both catecholamines and glucocorticoid hormones. Regardless of the physiological changes that make up the stress response, the stress response may contribute to an animal's decision to alter its behavior. Alternatively, a stimulus may not cause a measurable stress response but may act as an alert or cue to an animal to change its behavior. This response may occur because of learned associations; the animal may have experienced a stress reaction in the past to similar sounds or activities (Box C4), or it may have learned the response from conspecifics. The severity of the stress response depends on the *received sound level* at the animal (Box A2); the details of the *sound-producing activity* (Box A1); the *animal's life history stage* (e.g., juvenile or adult; breeding or feeding season) (Box B5); and the *animal's past experience* with the stimuli (Box B5). These factors would be subject to individual variation, as well as variation within an individual over time.

An *animal's life history stage* is an important factor to consider when predicting whether a stress response is likely (Box B5). An animal's life history stage includes its level of physical maturity (e.g., larva, infant, juvenile, sexually mature adult) and the primary activity in which it is engaged such as mating, feeding, or rearing/caring for young. Animals engaged in a critical life activity such as mating or feeding may have a lesser stress response than an animal engaged in a more flexible activity such as resting or migrating (i.e., an activity that does not necessarily depend on the availability of resources). The animal's past experiences with the stimuli or similar stimuli are another important consideration. Prior experience with a stressor may be of particular importance because repeated experience with a stressor may dull the stress response via acclimation (St. Aubin and Dierauf 2001) or increase the response via sensitization.

H.1.4 Behavioral Responses

Any number of *Behavioral Responses* can result from a physiological response. An animal responds to the stimulus based on a number of factors in addition to the severity of the physiological response. An animal's experience with the sound (or similar sounds), the context of the acoustic exposure, and the presence of other stimuli contribute to determining its reaction from a suite of possible behaviors.

Behavioral responses fall into two major categories: alterations in natural behavior patterns and avoidance. These types of reactions are not mutually exclusive, and many overall reactions may be combinations of behaviors or a sequence of behaviors. Severity of behavioral reactions can vary drastically between minor and brief reorientations of the animal to investigate the sound, to severe reactions such as aggression or prolonged flight. The type and severity of the behavioral response will determine the cost to the animal.

H.1.4.1 Trauma and Auditory Fatigue

Direct trauma and auditory fatigue increases the animal's *physiological stress* (Box B8), which feeds into the *stress* response (Box B7). Direct trauma and auditory fatigue increase the likelihood or severity of a behavioral response and *increase* an animal's overall physiological stress level (Box D10).

H.1.4.2 Auditory Masking

A behavior decision is made by the animal when the animal detects increased background noise, or possibly when the animal recognizes that biologically relevant sounds are being masked (Box C1). An *animal's past experience* with the sound-producing activity or similar acoustic stimuli can affect its choice of behavior during auditory masking (Box C4). *Competing and reinforcing stimuli* may also affect its decision (Box C5).

An animal can choose a passive behavioral response when coping with auditory masking (Box C2). It may simply not respond and keep conducting its current natural behavior. An animal may also decide to stop calling until the background noise decreases. These passive responses do not present a direct energetic cost to the animal; however, auditory masking will continue, depending on the acoustic stimuli.

An animal can choose to actively compensate for auditory masking (Box C3). An animal can vocalize more loudly to make its signal heard over the masking noise. An animal may also shift the frequency of its vocalizations away from the frequency of the masking noise. This shift can actually reduce the masking effect for the animal and other animals that are "listening" in the area. For example, in marine mammals, vocalization changes have been reported from exposure to anthropogenic noise sources such as sonar, vessel noise, and seismic surveying. Changes included mimicry of the sound, cessation of vocalization, increases and decreases in vocalization length, increases and decreases in vocalization rate, and increases in vocalization frequency and level, while other animals showed no significant changes in the presence of anthropogenic sound.

An *animal's past experiences* can be important in determining what behavior decision it may make when dealing with auditory masking (Box C4). Past experience can be with the sound-producing activity itself or with similar acoustic stimuli. For example, an animal may learn over time the best way to modify its vocalizations to reduce the effects of masking noise.

Other *stimuli* present in the environment can influence an animal's behavior decision (Box C5). These stimuli can be other acoustic stimuli not directly related to the sound-producing activity; they can be visual, olfactory, or tactile stimuli; the stimuli can be conspecifics or predators in the area; or the stimuli can be the strong drive to engage in a natural behavior. Competing stimuli can suppress any potential behavioral reaction. For example, an animal involved in mating or foraging may not react with the same degree of severity as it may have otherwise. Reinforcing stimuli reinforce the behavioral reaction caused by acoustic stimuli. For example, awareness of a predator in the area coupled with the acoustic stimuli may elicit a stronger reaction than the acoustic stimuli itself otherwise would have. The visual stimulus of seeing ships and aircraft, coupled with the acoustic stimuli, may also increase the likelihood or severity of a behavioral response.

H.1.4.3 Behavioral Reactions and Physiological Stress

A *physiological stress* response (Box B7) such as an annoyance or startle reaction, or a *cueing or alerting* reaction (Box B6) may cause an animal to make a *behavior decision* (Box C6). Any exposure that produces an injury or auditory fatigue is also assumed to produce a *stress* response (Box B7) and increase the severity or likelihood of a behavioral reaction. Both an animal's past experience (Box C4) and *competing and reinforcing stimuli* (Box C5) can affect an animal's behavior decision. The decision can result in three general types of behavioral reactions: *no response* (Box C9), *area avoidance* (Box C8), or *alteration of a natural behavior* (Box C7).

Little data exist that correlate specific behavioral reactions with specific stress responses. Therefore, in practice the likely range of behavioral reactions is estimated from the acoustic stimuli instead of the magnitude of the stress response. It is assumed that a stress response must exist to alter a natural behavior or cause an avoidance reaction. Estimates of the types of behavioral responses that could occur for a given sound exposure can be determined from the literature.

An *animal's past experiences* can be important in determining what behavior decision it may make when dealing with a stress response (Box C4). Past experience can be with the sound-producing activity itself or with similar sound stimuli. Bejder et al. (2009) define habituation as, "a process involving a reduction in response over time as individuals learn that there are neither adverse nor beneficial consequences of the occurrence of the stimulus." An animal habituated to a particular stimulus may have a lesser (or no) behavioral response to the stimulus compared to the first time the animal encountered the stimulus. Sensitization is the opposite of habituation, and refers to an increase over time in an animal's behavioral response to a repeated or continuous stimulus (Bejder et al. 2009). An animal sensitized to a particular stimulus exhibits an increasingly intense response to the stimulus (e.g., fleeing faster or farther), because there are significant consequences for the animal. A related behavioral response, tolerance, refers to an animal's ability to endure, or tolerate, a disturbance without a defined response. Habituation and sensitization are measured by the tolerance levels exhibited by animals; habituated animals show a progressively increasing tolerance to stimuli whereas sensitized animals show a progressively decreasing tolerance to stimuli (Bejder et al. 2009).

Other *stimuli* (Box C5) present in the environment can influence an animal's *behavior decision* (Box C6). These stimuli can be other acoustic stimuli not directly related to the sound-producing activity, such as visual stimuli; the stimuli can be conspecifics or predators in the area, or the stimuli can be the strong drive to engage or continue in a natural behavior. Competing stimuli tend to suppress any potential behavioral reaction. For example, an animal involved in mating or foraging may not react with the same degree of severity as an animal involved in less-critical behavior. Reinforcing stimuli reinforce the behavioral reaction caused by acoustic stimuli. For example, the awareness of a predator in the area coupled with the acoustic stimuli may elicit a stronger reaction than the acoustic stimuli themselves otherwise would have.

The visual stimulus of seeing human activities such as ships and aircraft maneuvering, coupled with the acoustic stimuli, may also increase the likelihood or severity of a behavioral response. It is difficult to separate the stimulus of the sound from the visual stimulus of the ship or platform creating the sound. The sound may act as a cue, or as one stimulus of many that the animal is considering when deciding how to react. An activity with several platforms (e.g., ships and aircraft) may elicit a different reaction than an activity with a single platform, both with similar acoustic footprints. The total number of vehicles and platforms involved, the size of the activity area, and the distance between the animal and activity are important considerations when predicting behavioral responses.

An animal may reorient or become more *vigilant* if it detects a sound-producing activity (Box C7). Some animals may *investigate* the sound using other sensory systems (e.g., vision), and perhaps move closer to the sound source. *Reorientation, vigilance, and investigation* all require the animal to divert attention and resources and therefore slow or stop their presumably beneficial natural behavior. This can be a very brief diversion, after which the animal continues its natural behavior, or an animal may not resume its natural behaviors until after a longer period when the animal has habituated to or learned to tolerate the sound or the activity has concluded. An intentional change via an orienting response represents

behaviors that would be considered mild disruption. More severe alterations of natural behavior would include *aggression or panic*.

An animal may choose to *leave or avoid an area* where a sound-producing activity is taking place (Box C8). Avoidance is the displacement of an individual from an area. A more severe form of this comes in the form of flight or evasion. A flight response is a dramatic change in normal movement to a directed and rapid movement away from the detected location of a sound source. Avoidance of an area can help the animal avoid further acoustic effects by avoiding or reducing further exposure.

An animal may choose *not to respond* to a sound-producing activity (Box C9). The physiological stress response may not rise to the level that would cause the animal to modify its behavior. The animal may have habituated to the sound or simply learned through past experience that the sound is not a threat. In this case a behavioral effect would not be predicted. An animal may choose not to respond to a sound-producing activity in spite of a physiological stress response. Some combination of competing stimuli may be present such as a robust food patch or a mating opportunity that overcomes the stress response and suppresses any potential behavioral responses. If the noise-producing activity persists over long periods or reoccurs frequently, the stress felt by animals could increase their chronic stress levels.

H.1.5 Costs to the Animal

The potential costs to a marine animal from an involuntary or behavioral response include no measurable cost, expended energy reserves, increased stress, reduced social contact, missed opportunities to secure resources or mates, displacement, and stranding or severe evasive behavior (which may potentially lead to secondary trauma or death). Animals suffer costs on a daily basis from a host of natural situations such as dealing with predator or competitor pressure. If the costs to the animal from an acoustic-related effect fall outside of its normal daily variations, then individuals must recover from significant costs to avoid long-term consequences.

H.1.5.1 Trauma

Trauma or injury to an animal may *reduce its ability to secure food* by *reducing its mobility* or the efficiency of its sensory systems, make the injured individual *less attractive to potential mates*, or increase *an individual's chances of contracting diseases or falling prey to a predator* (Box D2). A severe trauma can lead to the *death* of the individual (Box D1).

H.1.5.2 Auditory Fatigue and Auditory Masking

Auditory fatigue and masking can impair an animal's ability to hear biologically important sounds (Box D3), especially fainter and distant sounds. Sounds could belong to conspecifics such as other individuals in a social group (i.e., pod, school, etc.), potential mates, potential competitors, or parents/offspring. Biologically important sounds could also be an animal's own biosonar echoes used to detect prey, predators, and the physical environment. Therefore, auditory masking or a hearing loss could reduce an animal's ability to contact social groups, offspring, or parents; and reduce opportunities to detect or attract more distant mates. Animals may also use sounds to gain information about their physical environment by detecting the reverberation of sounds in the underwater space or sensing the sound of crashing waves on a nearby shoreline. These cues could be used by some animals to migrate long distances or navigate their immediate environment. Therefore, an animal's ability to navigate may be impaired if the animal uses acoustic cues from the physical environment to help identify its location.

Auditory masking and fatigue both effectively reduce the animal's acoustic space and the ocean volume in which detection and communication are effective.

An animal that *modifies its vocalization* in response to auditory masking could incur a cost (Box D4). Modifying vocalizations may cost the animal energy from its finite energy budget. Additionally, shifting the frequency of a call can make an animal appear to be less-fit to conspecifics. For example, songbirds that shift their calls up an octave to compensate for increased background noise attract fewer or less desirable mates. Larger animals are typically capable of producing lower-frequency sounds than smaller conspecifics. Therefore, lower-frequency sounds are usually an indicator of a larger and presumably more fit and experienced potential mate.

Auditory masking or auditory fatigue may also lead to no measurable costs for an animal. Masking could be of short duration or intermittent so that continuous or repeated biologically important sounds are received by the animal between masking noise. Auditory fatigue could also be inconsequential for an animal if the frequency range affected is not critical for that animal to hear within, or the auditory fatigue is of such short duration (a few minutes) that there are no costs to the individual.

H.1.5.3 Behavioral Reactions and Physiological Stress

An animal that alters its natural behavior in response to stress or an auditory cue may slow or cease its presumably beneficial natural behavior and instead *expend energy* reacting to the sound-producing activity (Box D5). Beneficial natural behaviors include *feeding, breeding, sheltering, and migrating*. The cost of feeding disruptions depends on the energetic requirements of individuals and the potential amount of food missed during the disruption. Alteration in breeding behavior can result in delaying reproduction. The costs of a brief interruption to migrating or sheltering are less clear. Most behavior alterations also require the animal to expend energy for a non-beneficial behavior. The amount of energy expended depends on the severity of the behavioral response.

An animal that avoids a sound-producing activity may *expend additional energy moving around the area, be displaced to poorer resources, miss potential mates, or have social interactions* affected (Box D6). Avoidance reactions can cause an animal to expend energy. The amount of energy expended depends on the severity of the behavioral response. Missing potential mates can result in delaying reproduction. Social groups or pairs of animals, such as mates or parent/offspring pairs, could be separated during a severe behavioral response such as flight. Offspring that depend on their parents may die if they are permanently separated. Splitting up an animal group can result in a reduced group size, which can have secondary effects on individual foraging success and susceptibility to predators.

Some severe behavioral reactions can lead to *stranding* (Box D7) or secondary *trauma* (Box D8). Animals that take prolonged flight, a severe avoidance reaction, may injure themselves or strand in an environment for which they are not adapted. Some *trauma* is likely to occur to an animal that strands (Box D8). Trauma can *reduce the animal's ability to secure food and mates*, and *increase the animal's susceptibility to predation and disease* (Box D2). An animal that strands and does not return to a hospitable environment quickly will likely *die* (Box D9).

Elevated stress levels may occur whether or not an animal exhibits a behavioral response (Box D10). Even while undergoing a stress response, competing stimuli (e.g., food or mating opportunities) may overcome an animal's initial stress response during the behavior decision. Regardless of whether the animal displays a behavioral reaction, this tolerated stress could incur a cost to the animal. Reactive oxygen species produced during normal physiological processes are generally counterbalanced by

enzymes and antioxidants; however, excess stress can result in an excess production of reactive oxygen species, leading to damage of lipids, proteins, and nucleic acids at the cellular level (Sies 1997; Touyz 2004).

H.1.6 RECOVERY

The predicted recovery of the animal (Box E1) is based on the cost of any masking or behavioral response and the severity of any involuntary physiological reactions (e.g., direct trauma, hearing loss, or increased chronic stress). Many effects are fully recoverable upon cessation of the sound-producing activity, and the vast majority of effects are completely recoverable over time; whereas a few effects may not be fully recoverable. The availability of resources and the characteristics of the animal play a critical role in determining the speed and completeness of recovery.

Available resources fluctuate by season, location, and year and can play a major role in an animal's rate of recovery (Box E2). Plentiful *food* can aid in a quicker recovery, whereas recovery can take much longer if food resources are limited. If many potential *mates* are available, an animal may recover quickly from missing a single mating opportunity. *Refuge* or shelter is also an important resource that may give an animal an opportunity to recover or repair after an incurred cost or physiological response.

An *animal's health, energy reserves, size, life history stage, and resource gathering strategy* affect its speed and completeness of recovery (Box E3). Animals that are in good health and have abundant energy reserves before an effect will likely recover more quickly. Adult animals with stored energy reserves (e.g., fat reserves) may have an easier time recovering than juveniles that expend their energy growing and developing and have less in reserve. Large individuals and large species may recover more quickly, also due to having more potential for energy reserves. Animals that gather and store resources, perhaps fasting for months during breeding or offspring rearing seasons, may have a more difficult time recovering from being temporarily displaced from a feeding area than an animal that feeds year round.

Damaged tissues from mild to moderate trauma may heal over time. The predicted recovery of direct trauma is based on the severity of the trauma, availability of resources, and characteristics of the animal. After a sustained injury an animal's body attempts to *repair* tissues. The animal may also need to *recover* from any potential costs due to a decrease in resource gathering efficiency and any secondary effects from predators or disease (Box E1). Moderate to severe trauma that does not cause mortality may never fully heal.

Small to moderate amounts of hearing loss may recover over a period of minutes to days, depending on the nature of the exposure and the amount of initial threshold shift. Severe noise-induced hearing loss may not fully recover, resulting in some amount of permanent hearing loss.

Auditory masking only occurs when the sound source is operating; therefore, direct masking effects stop immediately upon cessation of the sound-producing activity (Box E1). Natural behaviors may *resume* shortly after or even during the acoustic stimulus after an initial assessment period by the animal. Any energetic expenditures and missed opportunities to find and secure resources incurred from masking or a behavior alteration may take some time to *recover*.

Animals displaced from their normal habitat due to an avoidance reaction may *return* over time and *resume* their natural behaviors, depending on the severity of the reaction and how often the activity is repeated in the area. In areas of repeated and frequent acoustic disturbance, some animals may habituate to or learn to tolerate the new baseline or fluctuations in noise level. More sensitive species,

or animals that may have been sensitized to the stimulus over time due to past negative experiences, may not return to an area. Other animals may return but not resume use of the habitat in the same manner as before the acoustic-related effect. For example, an animal may return to an area to feed or navigate through it to get to another area, but that animal may no longer seek that area as refuge or shelter.

Frequent milder physiological responses to an individual may accumulate over time if the time between sound-producing activities is not adequate to give the animal an opportunity to fully recover. An increase in an animal's chronic stress level is also possible if stress caused by a sound-producing activity does not return to baseline between exposures. Each component of the stress response is variable in time, and stress hormones return to baseline levels at different rates. For example, adrenaline is released almost immediately and is used or cleared by the system quickly, whereas glucocorticoid and cortisol levels may take long periods (i.e., hours to days) to return to baseline.

H.1.7 Long-Term Consequences to the Individual and the Population

The magnitude and type of effect and the speed *and completeness of recovery* must be considered in predicting long-term consequences to the individual animal and its population (Box E). Animals that recover quickly and completely from explosive or acoustic-related effects will likely *not suffer reductions in their health or reproductive success, or experience changes in habitat utilization* (Box F2). *No population-level effects* would be expected if individual animals do not suffer reductions in their lifetime reproductive success or change their habitat utilization (Box F3).

Animals that do not recover quickly and fully could suffer *reductions in their health and lifetime reproductive success*; they could be permanently displaced or *change how they utilize the environment*; or they could *die* (Box F1).

Severe injuries can lead to reduced survivorship (longevity), elevated stress levels, and prolonged alterations in behavior that can reduce an animal’s lifetime reproductive success. An animal with decreased energy stores or a lingering injury may be less successful at mating for one or more breeding seasons, thereby decreasing the number of offspring produced over its lifetime.

An animal whose hearing does not recover quickly and fully could suffer a reduction in lifetime reproductive success, because it may no longer be able to detect the calls of a mate as well as it could prior to losing hearing sensitivity (Box F1). This example underscores the importance of the frequency of sound associated with the hearing loss and how the animal relies on those frequencies (e.g., for mating, navigating, detecting predators). An animal with decreased energy stores or a PTS may be less successful at mating for one or more breeding seasons, thereby decreasing the number of offspring it can produce over its lifetime.

As mentioned above, the involuntary reaction of masking ends when the acoustic stimuli conclude. The direct effects of auditory masking could have long-term consequences for individuals if the activity was continuous or occurred frequently enough; however, most of the proposed training and testing activities are normally spread over vast areas and occur infrequently in a specific area.

Missed mating opportunities can have a direct effect on reproductive success. Reducing an animal's energy reserves over longer periods can directly reduce its health and reproductive success. Some species may not enter a breeding cycle without adequate energy stores, and animals that do breed may have a decreased probability of offspring survival. Animals displaced from their preferred habitat, or

those who utilize it differently, may no longer have access to the best resources. Some animals that leave or flee an area during a noise-producing activity, especially an activity that is persistent or frequent, may not return quickly or at all. This can further reduce an individual's health and lifetime reproductive success.

Frequent disruptions to natural behavior patterns may not allow an animal to fully recover between exposures, which increase the probability of causing long-term consequences to individuals. Elevated chronic stress levels are usually a result of a prolonged or repeated disturbance. Excess stress produces reactive molecules in an animal's body that can result in cellular damage (Sies 1997; Touyz 2004). Chronic elevations in the stress levels (e.g., cortisol levels) may produce long-term health consequences that can reduce lifetime reproductive success.

These long-term consequences to the individual can lead to consequences for the *population* (Box F5). Population *dynamics and abundance* play a role in determining how many individuals would need to suffer long-term consequences before there was an effect on the population (Box G1). Long-term abandonment or a change in the utilization of an area by enough individuals can *change the distribution* of the population. Death has an immediate effect in that no further contribution to the population is possible, which reduces the animal's lifetime reproductive success.

Carrying capacity describes the theoretical maximum number of animals of a particular species that the environment can support. When a population nears its carrying capacity, the lifetime reproductive success in individuals may decrease due to finite resources or predator-prey interactions. *Population growth* is naturally limited by available resources and predator pressure. If one, or a few animals, in a population are removed or gather fewer resources, then other animals in the population can take advantage of the freed resources and potentially increase their health and lifetime reproductive success. Abundant populations that are near their carrying capacity (theoretical maximum abundance) that suffer effects to a few individuals may not be affected overall.

Populations that are reduced well below their carrying capacity (e.g., threatened or endangered species populations) may suffer greater consequences from any lasting effects to even a few individuals. Population-level consequences can include a change in the population dynamics, a decrease in the growth rate, or a change in geographic distribution. Changing the dynamics of a population (the proportion of the population within each age group or the ratio of sexually mature individuals) or their geographic distribution can also have secondary effects on population growth rates.

H.2 Conceptual Framework for Assessing Effects from Energy-Producing Activities

H.2.1 Stimuli

H.2.1.1 Magnitude of the Energy Stressor

Regulations do not provide threshold criteria to determine the significance of the potential effects from activities that involve the use of varying electromagnetic frequencies or lasers. Many organisms, primarily marine vertebrates, have been studied to determine their thresholds for detecting electromagnetic fields, as reviewed by Normandeau et al. (2011); however, there are no data on predictable responses to exposure above or below detection thresholds. The types of electromagnetic fields discussed are those from mine neutralization activities (magnetic influence minesweeping). The only types of lasers considered for analysis were low to moderate lasers (e.g., targeting systems,

detection systems, laser light detection and ranging) that do not pose a risk to organisms (Swope 2010), and therefore will not be discussed further.

H.2.1.2 Location of the Energy Stressor

Evaluation of potential energy exposure risks considered the spatial overlap of the resource occurrence and electromagnetic field and high energy laser use. Wherever appropriate, specific geographic areas of potential impact were identified. The greatest potential electromagnetic energy exposure is at the source, where intensity is greatest. The strength of the electromagnetic field decreases by the inverse square law (e.g., if the distance from sensor to source increases by a factor of three, the field strength is reduced by a factor of nine [$3^2 = 9$]). The greatest potential for high energy laser exposure is at the ocean's surface, where high energy laser intensity is greatest. As the laser penetrates the water, 96 percent of the beam is absorbed, scattered, or otherwise lost (Zorn et al. 2000; Ulrich 2004).

H.2.1.3 Behavior of the Organism

Evaluation of potential energy exposure risk considered the behavior of the organism, especially where the organism lives and feeds (e.g., surface, water column, seafloor). The analysis for electromagnetic devices considered those species with the ability to perceive or detect electromagnetic signals. The analysis for high energy lasers particularly considered those species known to inhabit the surface of the ocean.

H.2.2 Immediate Response and Costs to the Individual

Many different types of organisms (e.g., some invertebrates, fishes, turtles, birds, mammals) are sensitive to electromagnetic fields (Normandeau et al. 2011). An organism that encounters a disturbance in an electromagnetic field could respond by moving toward the source, moving away from it, or not responding at all. The types of electromagnetic devices used in the Proposed Action simulate the electromagnetic signature of a vessel passing through the water column, so the expected response would be similar to that of vessel movement. However, since there would be no actual strike potential, a physiological response would be unlikely in most cases. Recovery of an individual from encountering electromagnetic fields would be variable, but since the physiological response would likely be minimal, as reviewed by Normandeau et al. (2011), any recovery time would also be minimal.

Very little data are available to analyze potential impacts on organisms from exposure to high energy lasers. As with humans, the greatest laser-related concern for marine species is damage to an organism's ability to see. High energy lasers may also burn the skin, but the threshold energy level for eye damage is considerably lower, so the analysis considered that lower threshold. Recovery of the individual from eye damage or skin lesion caused by high energy lasers would be based on the severity of the injury and the incidence of secondary infection. Very few studies of this impact are available.

H.2.3 Long-Term Consequences to the Individual and Population

Long-term consequences are considered in terms of a resource's existing population level, growth and mortality rates, other stressors on the resource from the Proposed Action, cumulative impacts on the resource, and the ability of the population to recover from or adapt to impacts. Impacts of multiple or repeated stressors on individuals are cumulative. When stressors are chronic, an organism may experience reduced growth, health, or survival, which could have population-level impacts (Billard et al. 1981), especially in the case of endangered species.

H.3 Conceptual Framework for Assessing Effects from Physical Disturbance or Strike

H.3.1 Stimuli

H.3.1.1 Size and Weight of the Objects

To determine the likelihood of a strike and the potential impacts on an organism or habitat that would result from a physical strike, the size and weight of the striking object relative to the organism or habitat must be considered. Most small organisms and early life stages would simply be displaced by the movement generated by a large object moving through, or falling into, the water because they are planktonic (floating organisms) and move with the water; however, animals that occur at or near the surface could be struck. A larger nonplanktonic organism could potentially be struck by an object since it may not be displaced by the movement of the water. Sessile (nonmobile) organisms and habitats could be struck by the object, albeit with less force, on the seafloor. The weight of the object is also a factor that would determine the severity of a strike. A strike by a heavy object would be more severe than a strike by a low-weight object (e.g., a parachute, flare end cap, or chaff canister).

H.3.1.2 Location and Speed of the Objects

Evaluation of potential physical disturbance or strike risk considered the spatial overlap of the resource occurrence and potential striking objects. Analysis of impacts from physical disturbance or strike stressors focuses on proposed activities that may cause an organism or habitat to be struck by an object moving through the air (e.g., aircraft), water (e.g., vessels, in-water devices, towed devices), or dropped into the water (e.g., non-explosive practice munitions and seafloor devices). The area of operation, vertical distribution, and density of these items also play central roles in the likelihood of impact. Wherever appropriate, specific geographic areas of potential impact are identified. Analysis of potential physical disturbance or strike risk also considered the speed of vessels as a measure of intensity. Some vessels move slowly, while others are capable of high speeds.

H.3.1.3 Buoyancy of the Objects

Evaluation of potential physical disturbance or strike risk in the ocean considered the buoyancy of targets or expended materials during operation, which will determine whether the object will be encountered at the surface, within the water column, or on the seafloor. Once landed on the water surface, buoyant objects have the potential to strike plants and organisms that occur on the sea surface and negatively buoyant objects may strike plants and organisms within the water column or on the seafloor.

H.3.1.4 Behavior of the Organism

Evaluation of potential physical disturbance or strike risk considered where organisms occur and if they occur in the same geographic area and vertical distribution as those objects that pose strike risks.

H.3.2 Immediate Response and Costs to the Individual

Before being struck, some organisms would sense a pressure wave through the water and respond by remaining in place, moving away from the object, or moving toward it. An organism displaced a small distance by movements from an object falling into the water nearby would likely continue on with no response. However, others could be disturbed and may exhibit a generalized stress response. If the object actually hit the organism, direct injury in addition to stress may result. The function of the stress response in vertebrates is to rapidly raise the blood sugar level to prepare the organism to flee or fight.

This generally adaptive physiological response can become a liability if the stressor persists and the organism cannot return to its baseline physiological state.

Most organisms would respond to sudden physical approach or contact by darting quickly away from the stimulus. Other species may respond by freezing in place or seeking refuge. In any case, the individual must stop whatever it was doing and divert its physiological and cognitive attention to responding to the stressor. The energy costs of reacting to a stressor depend on the specific situation, but in all cases the caloric requirements of stress reactions reduce the amount of energy available to the individual for other functions such as predator avoidance, reproduction, growth, and metabolism.

The ability of an organism to return to what it was doing following a physical strike (or near miss resulting in a stress response) is a function of fitness, genetic, and environmental factors. Some organisms are more tolerant of environmental or human-caused stressors than others and become acclimated more easily. Within a species, the rate at which an individual recovers from a physical disturbance or strike may be influenced by its age, sex, reproductive state, and general condition. An organism that has reacted to a sudden disturbance by swimming at burst speed would tire after some time; its blood hormone and sugar levels may not return to normal for 24 hours. During the recovery period, the organism may not be able to attain burst speeds and could be more vulnerable to predators. If the individual were not able to regain a steady state following exposure to a physical stressor, it may suffer depressed immune function and even death.

H.3.3 Long-Term Consequences to the Population

Long-term consequences are considered in terms of a resource's existing population level, growth and mortality rates, other stressors on the resource from the Proposed Action, cumulative impacts on the resource, and the ability of the population to recover from or adapt to impacts. Impacts of multiple or repeated stressors on individuals are cumulative. When stressors are chronic, an organism may experience reduced growth, health, or survival, which could have population-level impacts (Billard et al. 1981), especially in the case of endangered species.

H.4 Conceptual Framework for Assessing Effects from Entanglement

H.4.1 Stimuli

H.4.1.1 Physical Properties of the Objects

For an organism to become entangled in military expended materials, the materials must have certain properties, such as the ability to form loops and a high breaking strength. Some items could have a relatively low breaking strength on their own, but that breaking strength could be increased if multiple loops were wrapped around an entangled organism.

H.4.1.2 Location of the Objects

Evaluation of potential entanglement risk considered the spatial overlap of the resource occurrence and military expended materials. Distribution and density of expended items play a central role in the likelihood of impact. Wherever appropriate, specific geographic areas of potential impact are identified.

H.4.1.3 Buoyancy of Objects

Evaluation of potential entanglement risk considered the buoyancy of military expended materials to determine whether the object will be encountered within the water column (including the surface) or on the seafloor. Less buoyant materials, such as torpedo guidance wires, sink rapidly to the seafloor. More

buoyant materials include less dense items (e.g., parachutes) that are weighted and would sink slowly to the seafloor and could be entrained in currents.

H.4.1.4 Behavior of the Organism

Evaluation of potential entanglement risk considered the general behavior of the organism, including where the organism typically occurs (e.g., surface, water column, seafloor). The analysis particularly considered those species known to become entangled in nonmilitary expended materials (e.g., "marine debris") such as fishing lines, nets, rope, and other derelict fishing gear that often entangle marine organisms.

H.4.2 Immediate Response and Costs to the Individual

The potential impacts of entanglement on a given organism depend on the species and size of the organism. Species that have protruding snouts, fins, or appendages are more likely to become entangled than smooth-bodied organisms. Also, items could get entangled by an organism's mouth, if caught on teeth or baleen, with the rest of the item trailing alongside the organism. Materials similar to fishing gear, which is designed to entangle an organism, would be expected to have a greater entanglement potential than other materials. An entangled organism would likely try to free itself of the entangling object and in the process may become even more entangled, possibly leading to a stress response. The net result of being entangled by an object could be disruption of the normal behavior, injury due to lacerations, and other sublethal or lethal impacts.

H.4.3 Long-Term Consequences to the Individual and Population

Consequences of entanglement could range from an organism successfully freeing itself from the object or remaining entangled indefinitely, possibly resulting in lacerations and other sublethal or lethal impacts. Stress responses or infection from lacerations could lead to latent mortality. The analysis will focus on reasonably foreseeable long-term consequences of the direct impact, particularly those that could impact the fitness of an individual. Changes in an individual's growth, survival, annual reproductive success, or lifetime reproductive success could have population-level impacts if enough individuals are impacted. This population-level impact would vary among species and taxonomic groups.

H.5 Conceptual Framework for Assessing Effects from Ingestion

H.5.1 Stimuli

H.5.1.1 Size of the Objects

To assess the ingestion risk from military expended materials, this analysis considered the size of the object relative to the animal's ability to swallow it. Some items are too large to be ingested (e.g., non-explosive practice bombs and most targets) and impacts from these items are not discussed further. However, these items may potentially break down into smaller ingestible pieces over time. Items that are of ingestible size when they are introduced into the environment are carried forward for analysis within each resource section where applicable.

H.5.1.2 Location of the Objects

Evaluation of potential ingestion risk considered the spatial overlap of the resource occurrence and military expended materials. The distribution and density of expended items play a central role in the likelihood of impact. Wherever appropriate, specific geographic areas of potential impact were identified.

H.5.1.3 Buoyancy of the Objects

Evaluation of potential ingestion risk considered the buoyancy of military expended materials to determine whether the object will be encountered within the water column (including the surface) or on the seafloor. Less buoyant materials, such as solid metal materials (e.g., projectiles or ordnance fragments), sink rapidly to the seafloor. More buoyant materials include less dense items (e.g., target fragments and parachutes) that may be caught in currents and gyres or entangled in floating *Sargassum*. These materials can remain in the water column for an indefinite period of time before sinking. However, parachutes are weighted and would generally sink, unless that sinking is suspended, in the scenario described here.

H.5.1.4 Feeding Behavior

Evaluation of potential ingestion risk considered the feeding behavior of the organism, including where (e.g., surface, water column, seafloor) and how (e.g., filter feeding) the organism feeds and what it feeds on. The analysis particularly considered those species known to ingest nonfood items (e.g., plastic or metal items).

H.5.2 Immediate Response and Costs to the Individual

Potential impacts of ingesting foreign objects on a given organism depend on the species and size of the organism. Species that normally eat spiny hard-bodied invertebrates would be expected to have tougher mouths and guts than those that normally feed on softer prey. Materials similar in size and shape to the normal diet of an organism may be more likely to be ingested without causing harm to the animal; however, some general assumptions were made. Relatively small objects with smooth edges, such as shells or small-caliber projectiles, might pass through the digestive tract without causing harm. A small sharp-edged item may cause the individual immediate physical distress by tearing or cutting the mouth, throat, or stomach. If the object is rigid and large (relative to the individual's mouth and throat), it may block the throat or obstruct digestive processes. An object may even be enclosed by a cyst in the gut lining. The net result of ingesting large foreign objects is disruption of the normal feeding behavior, which could be sublethal or lethal.

H.5.3 Long-Term Consequences to the Individual and Population

The consequences of ingesting nonfood items could be nutrient deficiency, bioaccumulation, uptake of toxic chemicals, compaction, and mortality. The analysis focused on reasonably foreseeable long-term consequences of the direct impact, particularly those that could impact the fitness of an individual. Changes in an individual's growth, survival, annual reproductive success, or lifetime reproductive success could have population-level impacts if enough individuals were impacted. This population-level impact would vary among species and taxonomic groups.

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Appendix I: Statistical Probability Analysis for Estimating Direct Air Strike Impact and Number of Potential Exposures

TABLE OF CONTENTS

APPENDIX I STATISTICAL PROBABILITY ANALYSIS FOR ESTIMATING DIRECT AIR STRIKE IMPACT AND NUMBER OF POTENTIAL EXPOSURES I-1

I.1 DIRECT IMPACT ANALYSIS I-1
I.2 PARAMETERS FOR ANALYSIS I-3
I.3 INPUT DATA I-4
I.4 OUTPUT DATA I-4

LIST OF TABLES

TABLE I-1: ESTIMATED ANNUAL MARINE MAMMAL EXPOSURES FROM DIRECT STRIKE OF MUNITIONS AND OTHER ITEMS BY AREA AND ALTERNATIVE I-5

LIST OF FIGURES

There are no figures in this section.

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APPENDIX I STATISTICAL PROBABILITY ANALYSIS FOR ESTIMATING DIRECT AIR STRIKE IMPACT AND NUMBER OF POTENTIAL EXPOSURES

This appendix discusses the methods and results for calculating the probability of a direct strike of an animal from any military items from the proposed training and testing activities falling toward (or directed at) the sea surface. For the purposes of this appendix, military items include non-explosive practice munitions, sonobuoys, acoustic countermeasures, and targets. Only marine mammals within the Offshore Area of the Northwest Training and Testing Study Area (Study Area) will be analyzed using these methods because the majority of activities that could impact marine mammals through strike impacts will occur in the Offshore Area and not in the Inland waters. Furthermore, the analysis conducted here does not account for explosive munitions because impacts from explosives are analyzed within the United States Department of the Navy (Navy) Acoustic Effects Model.

I.1 DIRECT IMPACT ANALYSIS

A statistical probability was calculated to estimate the impact probability (P) and number of exposures (T) associated with direct impact of military items on marine mammals on the sea surface within the specified training or testing area (R) in which the activities are occurring. The analysis does not account for lookouts and other mitigations the Navy uses to avoid marine mammal strikes. The statistical probability analysis is based on probability theory and modified Venn diagrams with rectangular "footprint" areas for the individual animal (A) and total impact (I) inscribed inside the training or testing area (R). The analysis assumes: (1) that all animals would be at or near the surface 100 percent of the time, when in fact, marine mammals spend the majority of their time underwater; and (2) that the animals are stationary, which does not account for any movement or any potential avoidance of the training or testing activity.

1. A = length*width, where the individual animal's width (breadth) is assumed to be 20 percent of its length for marine mammals. This product for A is multiplied by the number of animals N_a in the specified training or testing area (i.e., product of the highest average seasonal animal density [D] and training or testing area [R]: $N_a = D*R$) to obtain the total animal footprint area ($A*N_a = A*D*R$) in the training or testing area. As a worst case scenario, the total animal footprint area is calculated for the species with the highest average seasonal density in the training or testing area with the highest use of military items within the entire Study Area.

2. $I = N_{mun}$*length*diameter, where N_{mun} = total annual number of military items for each type, and "length" and "diameter" refer to the individual military equipment dimensions. For each type, the individual impact footprint area is multiplied by the total annual number of military items to obtain the type-specific impact footprint area ($I = N_{mun}$*length*diameter). Each training or testing activity uses one or more different types of military items, each with a specific number and dimensions, and several training and testing activities occur in a given year. When integrating over the number of military items types for the given activity (and then over the number of activities in a year), these calculations are repeated (accounting for differences in dimensions and numbers) for all military items types used, to obtain the type-specific impact footprint area (I). These impact footprint areas are summed over all military items types for the given activity, and then summed (integrated) over all activities to obtain the total impact footprint area resulting from all activities occurring in the training or testing area in a given year. As a worst case scenario, the total impact footprint area is calculated for the training or testing area with the highest use of military items within the entire Study Area.

Though marine mammals are not randomly distributed in the environment, a random point calculation was chosen due to the intensive data needs that would be required for a calculation that incorporated more detailed information on an animal's or military item's spatial occurrence.

The analysis is expected to provide an overestimation of the probability of a strike for the following reasons: (1) it calculates the probability of a single military item (of all the items expended over the course of the year) hitting a single animal at its species' highest seasonal density; (2) it does not take into account the possibility that an animal may avoid military activities; (3) it does not take into account the possibility that an animal may not be at the water surface; (4) it does not take into account that most projectiles fired during training and testing activities are fired at targets, and so only a very small portion of those projectiles that miss the target would hit the water with their maximum velocity and force; and (5) it does not quantitatively take into account the Navy avoiding animals that are sighted through the implementation of mitigation measures.

The likelihood of an impact is calculated as the probability (P) that the animal footprint (A) and the impact footprint (I) will intersect within the training or testing area (R). This is calculated as the area ratio A/R or I/R, respectively. Note that A (referring to an **individual** animal footprint) and I (referring to the impact footprint resulting from the **total** number of military items N_{mun}) are the relevant quantities used in the following calculations of single-animal impact probability [P], which is then multiplied by the number of animals to obtain the number of exposures (T). The probability that the random point in the training or testing area is within both types of footprints (i.e., A and I) depends on the degree of overlap of A and I. The probability that I overlaps A is calculated by adding a buffer distance around A based on one-half of the impact area (i.e., 0.5*I), such that an impact (center) occurring anywhere within the combined (overlapping) area would impact the animal. Thus, if L_i and W_i are the length and width of the impact footprint such that $L_i*W_i = 0.5*I$ and $W_i/L_i = L_a/W_a$ (i.e., similar geometry between the animal footprint and impact footprint), and if L_a and W_a are the length and width (breadth) of the individual animal such that $L_a*W_a = A$ (= individual animal footprint area), then, assuming a purely static, rectangular scenario (Scenario 1), the total area $A_{tot} = (L_a + 2*L_i)*(W_a + 2*W_i)$, and the buffer area $A_{buffer} = A_{tot} – L_a*W_a$.

Four scenarios were examined with respect to defining and setting up the overlapping combined areas of A and I:

1. **Scenario 1:** Purely static, rectangular scenario. Impact is assumed to be static (i.e., direct impact effects only; non-dynamic; no explosions or scattering of military items after the initial impact). Hence the impact footprint area (I) is assumed to be rectangular and given by the product of military items length and width (multiplied by the number of military items). $A_{tot} = (L_a + 2*L_i)*(W_a + 2*W_i)$ and $A_{buffer} = A_{tot} – L_a*W_a$.

2. **Scenario 2:** Dynamic scenario with end-on collision, in which the length of the impact footprint (Li) is enhanced by Rn = 5 military items lengths to reflect forward momentum. $A_{tot} = (L_a + (1 + R_n)*L_i)*(W_a + 2*W_i)$ and $A_{buffer} = A_{tot} – L_a*W_a$.

3. **Scenario 3:** Dynamic scenario with broadside collision, in which the width of the impact footprint (W_i) is enhanced by R_n = 5 military items lengths to reflect forward momentum. Atot = $(L_a + 2*W_i)*(W_a + (1 + R_n)*L_i)$ and $A_{buffer} = A_{tot} – L_a*W_a$.

4. **Scenario 4:** Purely static, radial scenario, in which the rectangular animal and impact footprints are replaced with circular footprints while conserving area. Define the radius (R_a) of the circular

individual animal footprint such that $\pi*R_a^2 = L_a*W_a$, and define the radius (R_i) of the circular impact footprint such that $\pi *R_i^2 = 0.5*L_i*W_i = 0.5*I$. Then $A_{tot} = \pi *(R_a + R_i)^2$ and $A_{buffer} = A_{tot} - \pi *R_a^2$ (where $\pi = 3.1415927$).

Static impacts (Scenarios 1 and 4) assume no additional areal coverage effects of scattered military items beyond the initial impact. For dynamic impacts (Scenarios 2 and 3), the distance of any scattered military items must be considered by increasing the length (Scenario 2) or width (Scenario 3), depending on orientation (broadside versus end-on collision), of the impact footprint to account for the forward horizontal momentum of the falling object. Forward momentum typically accounts for five object lengths, resulting in a corresponding increase in impact area. Significantly different values may result from these two types of orientation. Both of these types of collision conditions can be calculated each with 50 percent likelihood (i.e., equal weighting between Scenarios 2 and 3, to average these potentially different values).

Impact probability P is the probability of impacting one animal with the given number, type, and dimensions of all military items used in training or testing activities occurring in the area per year, and is given by the ratio of total area (A_{tot}) to training or testing area (R): $P = A_{tot}/R$. Number of exposures is $T = N*P = N*A_{tot}/R$, where N = number of animals in the training or testing area per year (given as the product of the animal density [D] and range size [R]). Thus, $N = D*R$ and hence $T = N*P = N*A_{tot}/R = D*A_{tot}$. Using this procedure, P and T were calculated for each of the four scenarios, for Endangered Species Act (ESA)-listed marine mammals and the marine mammals with the highest average seasonal density (used as the annual density value) and for each military item type. The scenario-specific P and T values were averaged over the four scenarios (using equal weighting) to obtain a single scenario-averaged annual estimate of P and T.

I.2 PARAMETERS FOR ANALYSIS

Impact probabilities (P) and number of exposures (T) were estimated by the analysis for the following parameters:

1. **Three proposed alternatives:** No Action Alternative, Alternative 1, and Alternative 2. Animal densities, animal dimensions, and military item dimensions are the same for the three alternatives.

2. **One training or testing areas:** The Offshore Area was chosen because it constitutes the area with the highest estimated numbers and concentrations of military expended materials for each alternative, and would, thus, provide a reasonable comparison for all other areas with fewer expended materials. Although a small number of munitions and other items are dropped from the air in the inland waters of Puget Sound (within the Dabob Bay Range Complex Site), none are expended in the western Behm Canal (Alaska).

3. **The following types of munitions or other items:**

   (a) **Small-caliber projectiles:** up to and including 0.50 caliber rounds
   (b) **Medium-caliber projectiles:** larger than 0.50 caliber rounds but smaller than 57-millimeter (mm) projectiles
   (c) **Large-caliber projectiles:** includes projectiles greater than or equal to a 57 mm projectile
   (d) **Missiles:** includes rockets and jet-propelled munitions

(e) **Bombs:** non-explosive practice bombs and mine shapes, ranging from 10 to 2,000 pounds (4.5 to 907.2 kilograms)
(f) **Torpedoes:** includes aircraft deployed torpedoes
(g) **Sonobuoys:** includes aircraft deployed sonobuoys

4. **Animal species of interest:** the seven species of ESA-listed marine mammals and the non-ESA listed marine mammal species with the highest average seasonal density in the training and testing area of interest.

I.3 INPUT DATA

Input data for the direct strike analysis include animal species likely to be in the area and military items proposed for use under each of the three alternatives. Animal species data include: (1) species ID and status (i.e., threatened, endangered, or neither), (2) highest average seasonal density estimate for the species of interest, and (3) adult animal dimensions (length and width) for the species with the highest density. The animal's dimensions are used to calculate individual animal footprint areas (A = length*width), and animal densities are used to calculate the number of exposures (T) from the impact probability (P): T = N*P. Military items data include: (1) military items category (e.g., projectile, bomb, rocket, target), (2) military items dimensions (length and width), and (3) total number of military items used annually.

Military items input data, specifically the quantity (e.g., numbers of guns, bombs, and rockets), are different in magnitude among the three proposed alternatives (No Action Alternative, Alternative 1, and Alternative 2). All animal species input data, the military items identification and category, and military items dimensions, are the same for the three alternatives, only the quantities (i.e., total number of military items) are different.

I.4 OUTPUT DATA

Estimates of impact probability (P) and number of exposures (T) for a given species of interest, were made for the specified training or testing area with the highest annual number of military items used for each of the three alternatives. The calculations derived P and T from the highest annual number of military items used in the Study Area for the given alternative. Differences in P and T among the alternatives arise from different numbers of events (and therefore military items) for the three alternatives.

Results for marine mammals are presented in Table I-1. The probabilities shown in the table are for any single year.

Table I-1: Estimated Annual Marine Mammal Exposures from Direct Strike of Munitions and Other Items by Area and Alternative

Northwest Training and Testing Range						
Offshore Area						
Species	**Training**			**Testing**		
	No Action	**Alternative 1**	**Alternative 2**	**No Action**	**Alternative 1**	**Alternative 2**
Blue whale	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Fin whale	0.00001	0.00002	0.00002	< 0.00001	< 0.00001	< 0.00001
Humpback whale	0.00018	0.00024	0.00024	< 0.00001	0.00001	0.00001
Killer whale	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
North Pacific right whale	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Sei whale	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Sperm whale	0.00006	0.00008	0.00008	< 0.00001	< 0.00001	< 0.00001
Pacific white-sided Dolphin[1]	0.00015	0.00019	0.00019	< 0.00001	< 0.00001	0.00001

[1] This is a non-Endangered Species Act-listed marine mammal species with the highest average seasonal density in the training and testing area of interest.

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