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3.8 SEA TURTLES

Sea turtles are long-lived reptiles that can be found throughout the world's tropical, subtropical, and temperate seas (CCC 2008). There are seven living species of sea turtles from two taxonomic families, the Cheloniidae (hard-shelled sea turtles six species) and the Dermochelyidae (leatherback turtles; one species). All sea turtles are listed under the Endangered Species Act (ESA).

Sea turtles are highly adapted for life in the marine environment. Sea turtles possess powerful, modified forelimbs (or flippers) that enable them to swim continuously for extended periods of time (Wyneken 1997). Sea turtles are among the longest and deepest diving of the air-breathing marine vertebrates, spending as little as three to six percent of their time at the water's surface (Lutcavage and Lutz 1997). Sea turtles often travel thousands of miles between their nesting beaches and feeding grounds (Ernst et al. 1994; Meylan 1995). Sea turtles cannot withdraw their head or limbs into their shell, so growing to a large size as adults is important to avoid predation.

Although they are specialized for life at sea, sea turtles begin their lives on land. Aside from this brief terrestrial period, which lasts approximately three months during egg incubation and hatching, sea turtles are rarely encountered out of the water. Sea turtles bask on the water surface to regulate their body temperatures, elude predators, possibly accelerate the development of their eggs, and destroy aquatic algae growth on their shells, known as carapaces (Whittow and Balazs 1982; Spotila et al. 1997). Mature females return to land to nest (Carr 1995; Spotila et al. 1997). Occasionally, sea turtles can also end up on the shore if they are dead, sick, injured, or cold-stressed. These events, known as strandings, can be caused by either biological factors (e.g., predation and disease) or environmental factors (e.g., water temperature).

The distribution of sea turtles in ocean waters off the U.S. west coast is strongly affected by seasonal changes in water temperature. Throughout much of the year, the Pacific coast of North America experiences cool water temperatures (less than 68°F [20°C]). Sea turtles are far less abundant in cool water temperatures than in warm waters (i.e., off southern California and Hawaii). Cool water temperatures also prevent sea turtles from nesting on U.S. west coast beaches and may also inhibit reproductive activity by reducing the quality and availability of food resources in the area (Fuentes et al. 2000). The northernmost known nesting sites of leatherbacks and olive ridley sea turtles in the eastern Pacific Ocean occur along the coast of Baja California (Fritts et al. 1982; Sarti-M. et al. 1996; López-Castro et al. 2000).

Over the last few centuries, sea turtle populations have declined dramatically because of human activities such as coastal development, oil exploration, commercial fishing, marine-based recreation, pollution, and over-harvesting (Natural Research Council 1990, Eckert 1995). As a result, all four species of sea turtles found in Northwest Training Range Complex (NWTRC) waters are currently listed as either threatened or endangered under the ESA. However, only the leatherback sea turtle occurs with any regularity in the open ocean portion of the NWTRC, referred to as the PACNW OPAREA. As such, this EIS/OEIS contains impact analysis for only the leatherback sea turtle. Although members of the Cheloniidae family occur in the warm, subtropical areas of southern California and Hawaii, the PACNW OPAREA is considered beyond their normal range of occurrence because of cold water temperatures. Although sightings of these species in the Study Area have been documented, most of these involve individuals that were either cold-stressed, likely to become cold-stressed, or already deceased (Hodge and Wing 2000; McAlpine et al. 2002). Thus, the PACNW OPAREA is considered to be outside the normal range for species of the Cheloniidae family, and they are not considered further for analysis in this EIS/OEIS.

The issues of concern for sea turtles include potential effects of sounds in the water, and impacts related to vessel movements, ordnance use, and possible entanglement or contact with expended materials that

are not recovered. The analysis of effects addresses these issues by grouping effects based on activities with common components such as vessel movement, ordnance use, and debris release.

3.8.1 Affected Environment

In general, sea turtle sightings off the U.S. west coast peak during July through September and in abnormally warm water years such as in El Niño years. During El Niño years, changes in ocean currents bring warmer waters north, which can bring more sea turtles (and their preferred prey) to the region (NMFS 2003). There is no known sea turtle nesting in the NWTRC Study Area.

3.8.1.1 Species Accounts and Life History

Leatherback Turtle (*Dermochelys coriacea*)

The leatherback is the only species of sea turtle expected to occur regularly in the Study Area. The leatherback, which is the largest living sea turtle, has a unique carapace structure. The carapace lacks the outer layer of bony external plates or scales possessed by all other sea turtles. Instead, it is composed of a flexible layer of dermal bones underlying tough, oily connective tissue and smooth skin. The body of a leatherback is barrel-shaped, tapered to the rear, with seven longitudinal dorsal ridges; the body is almost completely black with variable spotting (McDonald and Dutton 1996). Carapace lengths in adults range from about 50 to 70 inches (1.2 to 1.8 meters), with an average around 57 inches (1.4 meters). Adult leatherbacks weigh between 450 and 1,575 pounds (200 to 700 kilograms) (NMFS and USFWS 1998b).

The leatherback turtle was listed under the ESA as endangered throughout its range in June 1970. Critical habitat has not been identified for this species in the Pacific, largely because no nesting areas or important foraging areas have been identified in the Pacific (NMFS and USFWS 1998). As such, there is no designated critical habitat in the NWTRC Study Area for the leatherback turtle. However, because of the high potential for interactions between leatherback turtles and drift gillnet fisheries off the U.S. west coast during periods of warmer water, the NMFS has designated the eastern north Pacific Ocean area shown in Figure 3.9-1 as a Pacific Leatherback Conservation Zone, which has been proposed for critical habitat designation (Center for Biological Diversity et al. 2007). Within the Conservation Zone from August 15 through November 15 every year, fishing with drift gillnets with a mesh size equal to or greater than 14 inches (36 centimeters) is prohibited. The Conservation Zone is roughly located between Point Conception, California (34 27'N) and northern Oregon (45 N), and is described fully in 50 CFR 660.713(c). The Pacific Leatherback Conservation Zone provides this species with a strong level of protection from gillnets at the time of the year when they are known to reside off the U.S. west coast.

In December 2007, the NMFS issued a 90-day finding, concluding sufficient evidence had been provided by the petitioners (Center for Biological Diversity et al. 2007) to warrant revising critical habitat for the leatherback turtle to include the Conservation Zone (NMFS 2007). There is a recovery plan for this species (NMFS and USFWS 1998).

Leatherbacks are seriously declining at all major Pacific basin nesting beaches, including those in Indonesia, Malaysia, and southwestern Mexico (NMFS and USFWS 1998b). Lewison et al. (2004) estimated that more than 50,000 leatherbacks were taken worldwide as pelagic longline bycatch in 2000, and that thousands of these turtles die each year from longline gear interactions in the Pacific Ocean. Incidental capture of leatherbacks by the north Pacific high seas driftnet fleet, which targets squid and tuna, was also a source of mortality during the 1980s and early 1990s (Eckert 1993).

The leatherback turtle is distributed globally in tropical and subtropical waters throughout the year. Individuals will often move into cooler temperate and sometimes cold northern waters during late summer and early fall (Keinath and Musick 1990; James et al. 2005b).

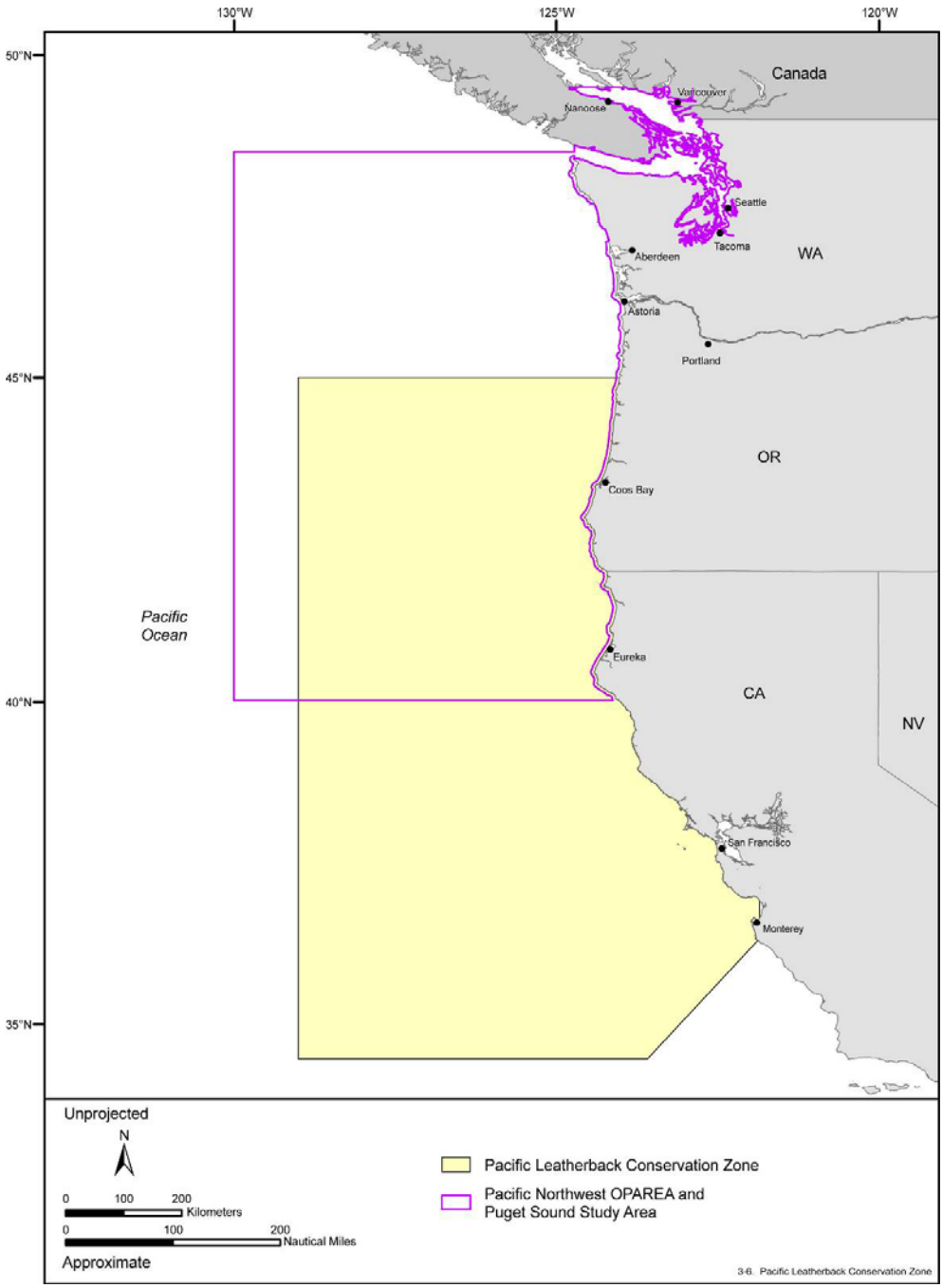

Figure 3.8-1: Location of the Pacific Leatherback Conservation Zone off the Coasts of California and Oregon

Of the seven living species of sea turtles, the leatherback is the most oceanic and has the widest range (Boulon et al. 1988). This can be attributed to the turtle's thermoregulatory capabilities, which enable leatherbacks to maintain body core temperatures well above the ambient water temperatures (Mrosovsky and Pritchard 1971; Greer et al. 1973; Neill and Stevens 1974; Goff and Stenson 1988; Paladino et al.

1990). As a result, they are more capable of surviving for extended periods of time in cooler waters than the hard-shelled sea turtles (Bleakney 1965; Lazell 1980).

Leatherback turtles primarily feed on gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (Bjorndal 1997; NMFS and USFWS 1998b). They have also been known to ingest longline hooks used to catch tuna and swordfish (Davenport and Balazs 1991; Skillman and Balazs 1992; Grant 1994; Work and Balazs 2002).

The leatherback is one of the deepest divers in the ocean, with dives deeper than 3,200 feet (975 meters) (Eckert et al. 1988). The leatherback dives continually and spends short periods of time on the surface between dives (Eckert et al. 1986; Southwood et al. 2003). Typical dive durations averaged 6.9 to 14.5 minutes per dive, with a maximum of 42 minutes (Eckert et al. 1996). During migrations or long distance movements, leatherbacks maximize swimming efficiency by traveling within 15 feet (5 meters) of the surface (Eckert 2002).

Historically, some of the world's largest nesting populations of leatherback turtles were found in the Pacific Ocean, although nesting on Pacific beaches under U.S. jurisdiction has always been rare (NMFS and USFWS 1998b). The northernmost nesting sites in the eastern Pacific Ocean are located in the Mexican states of Baja California Sur and Jalisco (Fritts et al. 1982). Other principal nesting sites in the Pacific Ocean indicate that gene flow between eastern and western Pacific nesting populations is restricted (Dutton et al. 1998, 1999, 2000a, 2000b).

In the northern Pacific Ocean, leatherback turtles are broadly distributed from the tropics to as far north as Alaska, where 19 occurrences were documented between 1960 and 2001 (Eckert 1993; Wing and Hodge 2002). After analyzing 363 records of sea turtles sighted along the Pacific coast of North America (from northern Mexico, northward), Stinson (1984) concluded that the leatherback was the most common sea turtle in eastern Pacific waters north of Mexico. Aerial surveys off the coasts of California, Oregon, and Washington have shown that most leatherback turtles occur in continental slope waters. (Green et al. 1992, 1993; Bowlby et al. 1994). Leatherbacks have also been sighted in shelf edge waters off Newport, Oregon, and Humboldt Bay, California (Smith and Houck 1984).

NMFS has indicated that during warm months, leatherbacks have the potential to occur in inshore waters of the Puget Sound. Stinson (1984) and McAlpine et al. (2004) reported inshore sightings of leatherbacks from waters as far north as Vancouver Island, British Columbia, and Cordova, Alaska. More recent studies (Dutton et al. 2000; Benson et al. 2007a, 2007b) have established that leatherbacks found off the U.S. west coast are part of the western Pacific population, which nests in Indonesia, Papua New Guinea, the Solomon Islands, and Vanuatu. The generalized migration of leatherback turtles in the northern Pacific Ocean is shown in Figure 3.8-2.

The western Pacific leatherback population was recently estimated to contain 2,700 to 4,500 nesting females (Dutton et al. 2007). A subset of these females, and an unknown number of males, forage off the U.S. west coast each year from about May to November, when dense aggregations of jellyfish (leatherback prey) are present (Benson et al. 2007a, 2007b). Foraging abundance estimates are only available for nearshore waters off California, where the estimated minimum leatherback abundance has ranged from 12 to 379 individuals per year, based on aerial surveys.

The PACNW OPAREA is an area of regular leatherback occurrence during the warm summer months. They forage on jellyfish while enroute to their nesting grounds on western Pacific island chains. The number of leatherback potentially occurring in the Study Area has not been estimated, but is expected to be less than that found to the south in warmer waters.

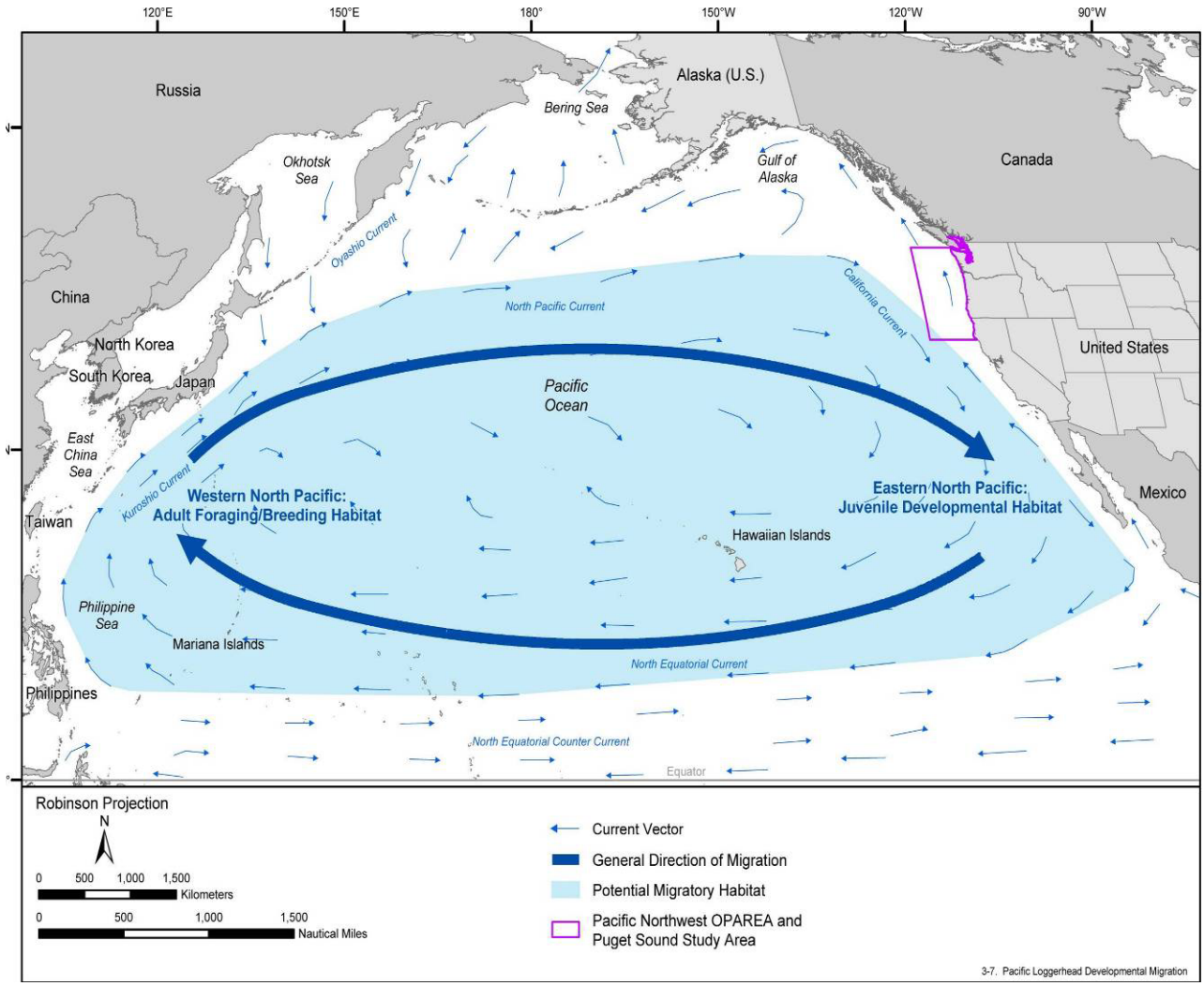

Figure 3.8-2: The Generalized Migration of Leatherback Turtles in the Northern Pacific Ocean

3.8.1.2 Sea Turtle Hearing

Sea turtles do not have an ear or eardrum. Instead, they have a cutaneous layer and underlying subcutaneous fatty layer that function as a tympanic membrane. The subcutaneous fatty layer receives and transmits sounds to the middle ear and into the cavity of the inner ear (Ridgway et al., 1969). Sound also arrives by bone conduction through the skull.

Little is known about the role of sound and hearing in sea turtle survival and only rudimentary information is available about responses to man-made noise. Sea turtles appear to be most sensitive to low frequencies. The effective hearing range for marine turtles is generally considered to be between 100 and 1000 Hz (Bartol et al. 1999; Lenhardt 1994; Moein et al. 1994; Ridgway et al., 1969). Hearing thresholds below 100 Hz were found to increase rapidly (Lenhardt 1994). Additionally, calculated in-water hearing thresholds at best frequencies (100 to 1000 Hz) appear to be high— 160 to 200 dB re 1µPa (Lenhardt 1994; Moein et al. 1994).

Sea turtle auditory capabilities and sensitivity is not well studied, though a few investigations suggest that it is limited to low-frequency bandwidths, such as the sounds of waves breaking on a beach. The role of underwater low-frequency hearing in sea turtles is unclear. It has been suggested that sea turtles may use acoustic signals from their environment as guideposts during migration and as a cue to identify their natal beaches (Lenhardt et al. 1983).

Ridgway et al. (1969) used aerial and mechanical stimulation to measure the cochlea in three specimens of green turtle, and concluded that they have a useful hearing span of perhaps 60 to 1,000 Hz, but hear best from about 200 Hz up to 700 Hz, with their sensitivity falling off considerably below 200 Hz. The maximum sensitivity for one animal was at 300 Hz, and for another was at 400 Hz. At the 400 Hz frequency, the turtle's hearing threshold was about 64 dB in air (approximately 126 dB in water). At 70 Hz, it was about 70 dB in air (approximately 132 dB in water). These values probably apply to all four of the hard-shell turtles (i.e., the green, loggerhead, hawksbill, and Kemp's ridley turtles). No audiometric data are available for the leatherback sea turtle, but based on other sea turtle hearing capabilities, they probably also hear best in the low frequencies.

Lenhardt et al. (1983) also applied audio-frequency vibrations at 250 Hz and 500 Hz to the heads of loggerheads and Kemp's ridleys submerged in salt water to observe their behavior, measure the attenuation of the vibrations, and assess any neural-evoked response. These stimuli (250 Hz, 500 Hz) were chosen as representative of the lowest sensitivity area of marine turtle hearing (Wever 1978). At the maximum upper limit of the vibratory delivery system, the turtles exhibited abrupt movements, slight retraction of the head, and extension of the limbs in the process of swimming. Lenhardt et al. (1983) concluded that bone-conducted hearing appears to be a reception mechanism for at least some of the sea turtle species, with the skull and shell acting as receiving surfaces.

A recent study on the effects of airguns on sea turtle behavior also suggests that sea turtles are most likely to respond to low-frequency sounds (McCauley et al. 2000). The pressure level is measured at a standard reference point such as 1 meter with a reference pressure of 1 µPa at 1 m (i.e., re 1 µPa-m). Green and loggerhead sea turtles will avoid air-gun arrays at 2 km and at 1 km, with received levels of 166 dB re 1 µPa at 1 m and 175 dB re 1 µPa, respectively (McCauley et al. 2000). The sea turtles' response was consistent: Above a level of about 166 dB re 1 µPa, the turtles noticeably increased their swimming activity. Above 175 dB re 1 µPa, their behavior became more erratic, possibly indicating that the turtles were agitated (McCauley et al. 2000).

Extrapolation from human and marine mammal data to turtles may be inappropriate given the morphological differences between the auditory systems of mammals and turtles. Currently it is believed that the range of maximum sensitivity for sea turtles is 0.1 to 0.8 kHz, with an upper limit of about 2.0 kHz (Lenhardt, 1994). Hearing below 0.08 kHz is less sensitive but still potentially usable to the animal. Green turtles are most sensitive to sounds between 0.2 and 0.7 kHz, with peak sensitivity at 0.3 to 0.4 kHz (Ridgway et al. 1997). They possess an overall hearing range of approximately 0.1 to 1.0 kHz (Ridgway et al., 1969). Juvenile loggerhead turtles hear sounds between 0.25 and 1.0 kHz and, therefore, often avoid these low frequency sounds (Bartol et al. 1999). Finally, sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB re 1 µPa-m (Lenhardt 1994). Given the lack of audiometric information, the potential for temporary threshold shifts among leatherback turtles must be classified as unknown but would likely follow those of other sea turtles. In terms of sound emission, nesting leatherback turtles produce sounds in the 0.3 to 0.5 kHz range (Mrosovsky 1972).

Mid-Frequency and High-Frequency Active Sonar

Any potential role of long-range acoustical perception in sea turtles has not been studied and is unclear at this time. The concept of sound masking (the ability of one sound to make the ear incapable of perceiving

another) is difficult, if not impossible, to apply to sea turtles. Hearing has been studied minimally in sea turtles and those that have been tested exhibited low audiometric and behavioral sensitivity to low-frequency sound. It appears that if there were the potential for mid and high frequency sonar to increase masking effects for any sea turtle species, it would be minimal as these sound sources are expected to be outside the normal hearing sensitivity of sea turtles.

Therefore, there will be no effect to sea turtles from mid and high frequency active sonar activities in the PACNW OPAREA under any of the proposed alternatives analyzed in the EIS/OEIS. These impacts are dismissed from further consideration.

3.8.1.3 Current Requirements and Practices

As summarized in Chapter 5, the comprehensive suite of protective measures and SOPs implemented by the Navy to reduce impacts to marine mammals also serves to mitigate potential impacts on sea turtles. In particular, personnel and watchstander training, establishment of turtle-free exclusion zones for underwater detonations of explosives, and pre- and post-exercise surveys, all serve to reduce or eliminate potential impacts of Navy activities on sea turtles that may be present in the vicinity.

3.8.2 Environmental Consequences

3.8.2.1 Approach to Analysis

Regulatory Framework

Endangered Species Act

This EIS/OEIS analyzes potential effects to the leatherback sea turtle in the context of the ESA, the National Environmental Policy Act (NEPA), and Executive Order (EO) 12114. For purposes of ESA compliance, effects of the action were analyzed to make the Navy's determination of effect for listed species (that is, no effect or may affect). The definitions used in making the determination of effect under Section 7 of the ESA are based on the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) *Endangered Species Consultation Handbook* (USFWS and NMFS 1998).

"No effect" is the appropriate conclusion when a listed species will not be affected, either because the species will not be present or because the project does not have any elements with the potential to affect the species. "No effect" does not include a small effect or an effect that is unlikely to occur.

If effects are insignificant (in size) or discountable (extremely unlikely), a "may affect" determination is appropriate. Insignificant effects relate to the magnitude or extent of the impact (that is, they must be small and would not rise to the level of a take of a species). Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. These factors were also considered in determining the significance of effects under the NEPA and EO 12114.

Pacific Northwest Turtle Protection Area

On March 11, 2004, NMFS issued a final rule to prohibit shallow longline fishing of the type normally targeting swordfish on the high seas in the Pacific Ocean east of 150ºW longitude by vessels managed under the Fishery Management Plan (FMP) for U.S. West Coast Fisheries for Highly Migratory Species. This action was intended to protect endangered and threatened sea turtles from the adverse impacts of shallow longline fishing by U.S. fishing vessels in the Pacific Ocean and operating out of the west coast. The FMP was partially approved by NMFS on February 4, 2004. Together, the final rule and FMP are expected to conserve leatherback and loggerhead sea turtles as required under the ESA.

Assessment Methods and Data Used

The Navy used a screening process to identify aspects of the proposed action that could act as stressors to sea turtles. Public and agency scoping comments, previous environmental analyses, previous agency consultations, laws, regulations, Executive Orders, and resource-specific information were also evaluated. This process was used to focus the information presented and analyzed in the affected environment and environmental consequences sections of this EIS/OEIS. Potential stressors to sea turtles include vessel movements (disturbance and collisions), aircraft overflights (disturbance), weapons firing and ordnance use (disturbance and strikes), explosions, and expended materials (ordnance related materials, targets, and marine markers).

As discussed in sections 3.3, Hazardous Materials, and 3.4, Water Resources, potential pollutants in sediments, water, and air would be released into the environment as a result of the alternatives. The analyses presented in those sections indicate that any increases in pollutants resulting from Navy training in the NWTRC Study Area would be negligible and localized, and impacts would not be significant. Based on these analyses, water quality changes would have negligible effects on sea turtles. Accordingly, the effects of water quality changes on sea turtles were not addressed further in this EIS/OEIS.

Study Area

The Study Area for sea turtles includes both the offshore and inshore waters of the NWTRC.

Data Sources

A systematic review of relevant literature and data was conducted of both published and unpublished sources. The following types of documents were used in the assessment: journals, books, periodicals, bulletins, DoD operations reports, theses, dissertations, endangered species recovery plans, species management plans, and other technical reports published by government agencies, private businesses, and consulting firms. The scientific literature was also consulted during the search for geographic location data (geographic coordinates) on the occurrence of sea turtles within the Study Area.

Turtle Density

There are no formal density estimates for sea turtles in the PACNW OPAREA. The marine mammal and sea turtle density study undertaken to support the analysis presented in the EIS/OEIS (ManTech-SRS 2007) estimated the average density of sea turtles along the Southern California coast to be 3.6 animals per 30 square nautical mile (nm^2) (100 square kilometers [km^2]), equal to an estimated maximum of 7.7 animals over the same area (0.12 to 0.26 animals per nm^2). Although the cold water temperatures of the Pacific Northwest make occurrence of several hard-shelled species unlikely, the density estimate for Southern California is employed here as a potential maximum range of occurrence for sea turtles in the Study Area. Thus, the assumed density of 0.12 to 0.26 turtles per nm^2 (3.4 km^2) is an extrapolation that represents a high rate of occurrence that may exceed actual conditions.

Sound in the Water

As discussed in section 3.8.1.2 (Sea Turtle Hearing) above, no effects on sea turtles are anticipated from mid-frequency or high-frequency active sonar, and this topic is not carried through the analysis.

Underwater Explosions and Detonations

Criteria and thresholds for estimating the impacts to sea turtles from a single underwater detonation event were determined from information on cetaceans used for the environmental assessments for the two Navy ship-shock trials: the *Seawolf* Final EIS (DoN 1998) and the *Churchill* Final EIS (DoN 2001). During the analysis of the effects of explosions on marine mammals and sea turtles conducted by the Navy for the *Churchill* EIS, analysts compared the injury levels reported by these experiments to the injury levels that

would be predicted using the modified-Goertner method and found them to be similar (DoN 2001; Goertner 1982). The criteria and thresholds for injury and harassment are summarized in Table 3.8-1.

Table 3.8-1: Summary of Criteria and Acoustic Thresholds for Underwater Detonation Impacts to Marine Mammals but Also Used for Sea Turtles Because No Other Criteria Exists

Impact to Marine Mammal	Criterion	Threshold
Level A Harassment Mortality	Onset of Severe Lung Injury	Goertner Modified Positive Impulse Indexed to 31 psi-ms
Injury	Tympanic membrane rupture Onset of slight lung injury	50 percent rate of rupture; 205 dB re 1 μPa^2-s (Energy Flux Density) Goertner Modified Positive Impulse Indexed to 13 psi-ms
Level B Harassment Non-Injury	Temporary Threshold Shift (TTS)	182 dB re 1 μPa^2-s maximum Energy Flux Density level in any 1/3-octave band at frequencies above 100 Hz for sea turtles.
Dual Criteria	Onset Temporary Threshold Shift	23 psi peak pressure level (for small explosives)
psi-ms = pounds per square inch-milliseconds, μPa^2-s = squared micropascal-second		

The criteria for non-injurious harassment include acoustic annoyance and physical discomfort (Viada et al. 2007). Temporary threshold shift (TTS) is the criterion for acoustic annoyance; TTS is a temporary, recoverable, loss of hearing sensitivity (NMFS 2001; DoN 2001). There are two criteria for TTS: 1) 182 dB re 1 squared micropascal-second (μPa^2-s) maximum Energy Flux Density Level (EL) level in any 1/3-octave band at frequencies greater than 100 Hz for sea turtles; and 2) 12 pounds per square inch (psi) peak pressure. Navy policy is to use the 23 psi criterion for explosive charges less than 2,000 pounds (900 kg) and the 12 psi criterion for explosive charges larger than 2,000 pounds. It was introduced to provide a safety zone for TTS when the explosive or the animal approaches the sea surface (for which case the explosive energy is reduced but the peak pressure is not). In addition to acoustic annoyance, non-injurious harassment may also include physical discomfort and tactile detection, particularly in areas around the eyes, mouth, external nares, and vent (Viada et al. 2007).

Two criteria are used for injury: onset of slight lung hemorrhage and 50 percent eardrum (tympanic membrane [TM]) rupture. These criteria are considered indicative of the onset of injury. The threshold for onset of slight lung injury is calculated for a small animal (a dolphin calf weighing 27 pounds [12 kg]), and is given in terms of the "Goertner modified positive impulse," indexed to 13 psi-millisecond (ms) (DoN 2001). In the absence of analagous data in chelonids, the criteria developed for marine mammals is also applied to sea turtles. This threshold is conservative since the positive impulse needed to cause injury is proportional to animal mass, and therefore, larger animals require a higher impulse to cause the onset of injury. The threshold for TM rupture corresponds to a 50 percent rate of rupture (i.e., 50 percent of animals exposed to the level are expected to suffer TM rupture); this is stated in terms of an EL value of 205 dB re 1 μPa^2-s. The criterion reflects the fact that TM rupture is not necessarily a serious or life-threatening injury, but is a useful index of possible injury that is well correlated with measures of permanent hearing impairment (e.g., Ketten 1998) indicates a 30 percent incidence of permanent threshold shift [PTS] at the same threshold. Another slight injury that may result from underwater explosion shock waves includes hemorrhage of the gastrointestinal tract. This is caused by excitation of radial oscillations of small gas bubbles normally present in the intestine. Hemorrhage of the

gastrointestinal tract is not expected to be debilitating and a sea turtle would be expected to recover on its own (Viada et al. 2007).

The criterion for mortality for marine mammals used in the *Churchill* Final EIS is "onset of severe lung injury." This is conservative in that it corresponds to a 1 percent chance of mortal injury, and yet any animal experiencing onset severe lung injury is counted as a lethal exposure. The threshold is stated in terms of the Goertner (1982) modified positive impulse with value "indexed to 31 psi-ms." Since the Goertner approach depends on propagation, source/animal depths, and animal mass, the actual impulse value corresponding to the 31 psi-ms index is a complicated calculation. Again, to be conservative, the *Churchill* analysis used the mass of a calf dolphin (27 pounds [12 kg]), so that the threshold index is 30.5 psi-ms. Gastrointestinal tract injuries are associated with lung hemorrhage and would be expected to include contusions with ulcerations throughout the tract, ultimately resulting in tract ruptures. Mortality is highly likely under these conditions (Viada et al. 2007). Lethal injuries may also result from shock waves with high peak pressure. These high peak pressure shock waves may result in concussive brain damage; cranial, skeletal, or shell fractures; hemorrhage; or massive inner ear trauma, leading either directly or indirectly to mortality (Viada et al. 2007).

Weapons Firing Disturbance

A gun fired from a vessel on the surface of the water propagates a blast wave away from the gun muzzle. As the blast wave hits the water, sound is carried into the water in proportion to the blast strike. Propagating energy is transmitted into the water in a finite region below the gun. A critical angle (about 13°, as measured from the vertical) can be calculated to determine the region of transmission in relation to a vessel and gun (DoN 2006d).

The largest proposed shell size for NWTRC training activities is a 5-inch shell. This will produce the greatest pressure of all ammunition used in the NWTRC Study Area. All analysis will be done using the 5-inch shell as a source of produced and transmitted pressure, with the recognition that smaller ammunition sizes would have lesser impacts.

In June 2000, the Navy collected a series of pressure measurements during the firing of a 5-inch gun. Average pressure measured approximately 200 decibels with reference pressure of one micro Pascal (200 dB re 1 μPa) at the point of the air and water interface. Based on these values, down-range peak pressure levels were calculated to be less than 186 dB re 1 μPa at 100 meters (DoN 2000), and as the distance increased, the pressure decreased. The rapid dissipation of the sound pressure wave, the low potential for occurrence of sea turtles in the PACNW OPAREA, and the protective measures implemented by the Navy (see Chapter 5 for details) to detect sea turtles in an area prior to implementing training activities, would result in the gun muzzle blasts having no effect on sea turtle species. This topic is not addressed further in the analyses of effects on sea turtles.

3.8.2.2 No Action Alternative

Under the No Action Alternative, baseline levels of activities would remain unchanged from current conditions. Turtles would have the potential to be affected by vessel movements, aircraft overflights, ordnance strikes, explosions, and expended materials.

Vessel Movements

Training activities within the Study Area involve maneuvers by various types of surface vessels and submarines (collectively referred to as vessels). Vessel movements have the potential to affect sea turtles by directly striking or disturbing individual animals. The probability of vessel and sea turtle interactions in the PACNW OPAREA depends factors such as the presence or absence and density of sea turtles;

numbers, types, and speeds of vessels; duration and spatial extent of activities; and protective measures implemented by the Navy.

Currently, the number of Navy vessels operating in the PACNW OPAREA varies based on training schedules. Most training activities average one vessel per activity. During a year of training activities, 6,940 steaming hours occur in the NWTRC, with 4,320 of those in transit, and 2,620 during training activities. Although Navy vessels are capable of much faster speeds, specific training activities generally dictate slower speeds – generally in the range of 10 to 14 knots.

Training activities involving vessel movements occur intermittently and are short in duration (generally a few hours). These activities are widely dispersed throughout the PACNW OPAREA, which encompasses 122,241 nm^2 (419,287 km^2) of surface and subsurface ocean. The Navy logs about 289 total vessel days within the Study Area during a typical year, which equates to about 0.06 hours (or 3 minutes) of steaming per nm^2 (3.4 km^2) annually. The estimated density of turtle occurrence in the Study Area is from 0.012 to 0.26 animals per nm^2 (3.4 km^2).

Disturbance from Vessel Movement

The ability of turtles to detect approaching vessels via auditory or visual cues would be expected based on knowledge of their sensory biology (Bartol and Musick 2003; Ketten and Bartol 2006; Moein Bartol and Ketten 2006; Levenson et al. 2004). Little information is available on how turtles respond to vessel approaches. Hazel et al. (2007) reported that greater vessel speeds increased the probability turtles would fail to flee from an approaching vessel. Turtles fled frequently in encounters with a slow-moving (2.2 knots) vessel, but infrequently in encounters with a moderate-moving (5.9 knots) vessel, and only rarely in encounters with a fast-moving (10.3 knots) vessel. It is difficult to differentiate whether a sea turtle reacts to a vessel due to the produced sound, the presence of the vessel itself, or a combination of both.

Sea turtles possess an overall hearing range of approximately 100 to 1,000 Hz, with an upper limit of 2,000 Hz (Ridgway et al. 1969; Lenhardt et al. 1994; Bartol et al. 1999; Ketten and Moein Bartol 2006). Although it is difficult to determine whether sea turtle response to vessel traffic is visual or auditory in nature, it is assumed sea turtles can hear approaching vessels given their hearing range.

Hazel et al. (2007) found that sea turtles reacted to approaching vessels in a variety of ways and that those reactions were short-term. Benthic turtles launched upwards at a shallow angle and began swimming. The majority of the turtles swam away from the vessel while some swam along the vessel's track and some crossed in front of the vessel's track before swimming away. Sea turtle reaction time depends on the speed of the vessel; sea turtles were able to react faster to slower moving vessels than to faster moving vessels.

Human disturbance to wild animals may elicit similar reactions to those caused by natural predators (Gill et al. 2001; Beale and Monaghan 2004). Behavioral responses may also be accompanied by a physiological response (Romero 2004), although this is difficult to study in the wild. Immature Kemp's ridley turtles have shown physiological responses to the acute stress of capture and handling through increased levels of corticosterone (Gregory and Schmid 2001). In the short term, exposure to stressors results in changes in immediate behavior (Frid 2003). For turtles, this can include intense behavioral reactions such as biting and rapid flipper movement (Gregory and Schmid 2001). Repeated exposure to stressors, including human disturbance such as vessel disturbance and anthropogenic sound, can result in negative consequences to the health and viability of an individual or population. Chronic stress can result in decreased reproductive success (Lordi et al. 2000; Beale and Monaghan 2004), decreased energy budget (Frid 2003), displacement from habitat (Southerland and Crockford 1993), and lower survival rates of offspring (Lordi et al. 2000). Although this study related to natural induced stressors, similar

physiological changes may result from other types of stressors such as anthropogenic disturbance. At this time, it is unknown what the long-term implications of chronic stress may be on sea turtle species.

Sea turtles exposed to the general disturbance associated with a passing Navy vessel could exhibit a short-term behavioral response such as fleeing. In accordance with the NEPA, vessel movements in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would possible but unlikely. In accordance with the ESA, vessel disturbance under the No Action Alternative may affect leatherback turtles.

Vessel Collisions

Vessel collisions with sea turtles, or vessel strikes, have the potential to affect sea turtles in the Study Area. Turtles swimming or feeding at or just beneath the surface of the water are particularly vulnerable to a vessel strike. Sea turtles struck by vessels could be unharmed, injured, or killed.

As discussed for disturbance effects to sea turtles, above, collisions between vessels and sea turtles are possible, but have a low potential for occurrence. The low density rates for turtles, low number of annual steaming hours over a large area (122,241 nm^2 [419,287 km^2]), and Navy resource protection measures would combine to limit the likelihood of vessel-turtle collisions.

In accordance with the NEPA, vessel strikes in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would be possible but unlikely. In accordance with the ESA, vessel disturbance under the No Action Alternative may affect leatherback turtles.

Aircraft Overflights

Under the No Action alternative, 7,586 overflights would occur above the NWTRC annually. Of these, 96 would be helicopter flights, conducted primarily over land. Nearly 7,500 of the non-helicopter overflights would occur over the PACNW OPAREA, at elevations in excess of 3,000 feet (915 meters), and more than three nautical miles (5.5 km) from shore.

Aircraft overflights produce noise, and some of this sonic energy would be transmitted into the water. Sea turtles could be exposed to noise associated with fixed-wing aircraft overflights and helicopter activities while at the surface or while submerged. In addition, low-flying aircraft passing overhead could create a visual shadow effect that could induce a reaction in sea turtles.

It is difficult to differentiate between reactions that turtles may experience to the presence of aircraft and reactions to sound. Exposures to elevated noise levels that are associated with current activities are brief and infrequent, based on the transitory and dispersed nature of the overflights. Sound exposure levels are relatively low because sea turtles spend only 3 to 6 percent of the time at the sea surface and because most of the overflights would be above 3,000 feet (915 meters).

Little data regarding sea turtle reactions to aircraft overflights are available. Based on information on their sensory biology (Ridgway et al. 1969; Lenhardt 1994; Bartol et al. 1999; Bartol and Musick 2003; Ketten and Bartol 2006), sound from low-flying aircraft could be heard by a sea turtle at or near the surface. Hazel et al. (2007) suggested that green turtles rely more on visual cues than auditory cues when reacting to approaching water vessels. This suggests that sea turtles might not respond to aircraft overflights based on noise alone. Overflights do not generate underwater sound levels that result in harm to sea turtles (Eller and Cavanagh 2000; Laney and Cavanagh 2000).

Sea turtles exposed to aircraft overflights that occur under the No Action Alternative may exhibit no response, or may exhibit behavioral reactions such as quick diving. Any behavioral avoidance reaction would be short-term and would not permanently displace animals or result in physical harm. Overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed to low-altitude overflights. In accordance with the NEPA, aircraft overflights in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would be possible but unlikely. In accordance with the ESA, aircraft overflights under the No Action Alternative may affect leatherback turtles.

Non-Explosive Ordnance Use

Current Navy training activities in the PACNW OPAREA include firing a variety of weapons that employ non-explosive training rounds, including inert bombs, missiles, naval gun shells, cannon shells, and small-caliber ammunition. These materials are used in the PACNW OPAREA located in the open ocean beyond three nautical miles (5.5 km) and represent potential stressors to sea turtles. Ordnance strikes have the potential to injure or kill sea turtles in the Study Area. Turtles swimming or feeding at or just beneath the water surface are particularly vulnerable to an ordnance strike.

Approximately 86,000 non-explosive ordnance rounds would be used in the PACNW OPAREA annually under the No Action Alternative. Although use may be concentrated in W-237, ordnance is used in all areas of the PACNW OPAREA beyond three nautical miles (5.5 km). The density of annual ordnance use would be approximately 0.7 items per nm^2 (3.4 km^2) over the 122,241 nm^2 (419,287 km^2) range. Using the turtle density estimate extrapolated from Southern California, 0.12 to 0.26 turtles could occur per nm^2 (3.4 km^2) within the Study Area. Given the relatively small size of the turtles (up to 70 inches [1.8 meters]) and the ordnance used (from less than one inch [2.5 centimeters] to 8 feet [2.4 meters]), the potential for turtles to be struck by ordnance is low. Consistent use of Navy protective measures would also help minimize the likelihood of ordnance strikes to sea turtles.

In accordance with the NEPA, non-explosive ordnance use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from non-explosive ordnance use in non-territorial waters would be possible but unlikely. In accordance with the ESA, non-explosive ordnance strikes under the No Action Alternative may affect leatherback sea turtles.

Underwater Detonations and Explosive Ordnance

Explosions that would occur in the No Action Alternative in the Study Area would result from training exercises that use explosive ordnance, including bombs (BOMBEX), missiles (MISSILEX), and SINKEX. They also would result from underwater detonations associated with explosive ordnance detonation (EOD) training. Explosive ordnance use and underwater detonation would be limited to the training areas that were identified in Table 2-9.

Underwater explosions conducted under the No Action Alternative have the potential to adversely affect sea turtles in the Study Area by causing temporary behavioral effects, sub-lethal or lethal injuries, or direct mortality.

However, the same factors that would limit other adverse effects to sea turtles would result in a low potential for impacts from explosions. These include the relatively low potential for sea turtles to occur in the Study Area, the limited number of training activities using explosive ordnance over a large area (122,241 nm^2 [419,287 km^2]), and consistent implementation of Navy resource protection measures.

Under the No Action Alternative, approximately 27 bomb and missile explosions would occur each year during training activities in the PACNW OPAREA. In addition, 124 explosive sonobuoys would be used.

Although use of these explosive training components would be concentrated in W-237, their use may occur in all areas of the PACNW OPAREA beyond three nautical miles (5.5 km). The occurrence density of annual ordnance use would be approximately 0.0012 detonations per nm^2 (3.4 km^2) over the entire PACNW OPAREA.

Although the leatherback sea turtle generally occurs in the offshore areas of the PACNW OPAREA, they have been sited, on rare occasions, in the waters of Puget Sound. In the unusual event that a sea turtle were in the vicinity of underwater EOD activities, they could be exposed to noise and the pressure wave from the detonation. However, the monitoring and protective measures undertaken prior to any detonation of EOD would reduce the likelihood of sea turtles being injured or exposed to such explosions. With the low occurrence rate and protective measures employed, impacts from underwater EOD may affect leatherback sea turtles.

An explosive analysis was conducted to estimate the number of sea turtles that could be exposed to impacts from explosions. (See Section 3.8.2.1 for sea turtle-specific thresholds and Section 3.9, Marine Mammals, for a full description of the modeling and methods.) Each explosion or detonation generates a zone of influence, that is, the area where leatherback turtles would potentially be exposed to the resulting pressure wave. Under the No Action Alternative, the explosions and detonations that would take place in the Study Area would have the potential to affect two leatherback sea turtles – one would potentially be affected at the dual criteria (23 psi peak pressure from small explosives) level and one potentially affected at non-injurous behavior disruption level. No sea turtles mortalities would be expected under this alternative. The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that unavoidable significant effects to sea turtles do not result from implementation of the proposed action.

In accordance with the NEPA, explosive ordnance use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from explosive ordnance use in non-territorial waters would be possible but unlikely. In accordance with the ESA, use of explosive ordnance in the PACNW OPAREA under the No Action Alternative may affect leatherback sea turtles.

Expended Materials

The Navy expends a variety of materials during training exercises in the PACNW OPAREA. The types and quantities of materials expended and information regarding fate and transport of these materials within the marine environment are discussed in Section 3.1, Geology and Soils; Section 3.3, Hazardous Materials; and Section 3.4, Water Resources. The analyses in these sections determined that most expended materials rapidly sink to the sea floor where they become encrusted by natural processes or are incorporated into the sea floor, with no substantial accumulations in any particular area and no significant negative effects to water quality or marine benthic communities.

Sea turtles of all sizes and species are known to ingest a wide variety of marine debris, which they might mistake for prey. Plastic bags and plastic sheeting are most commonly swallowed by sea turtles, but balloons, Styrofoam beads, monofilament fishing line, and tar are also known to be ingested (NRC 1990;). Marine debris can pass through the digestive tract and be voided naturally without causing harm, or it can cause sublethal or lethal effects (Balazs 1985). Sublethal effects include nutrient dilution, which occurs when non-nutritive debris displaces nutritious food in the gut, leading to slow growth or reduced reproductive success (McCauley and Bjorndal 1999).

Lutz (1997) found that hungry sea turtles will actively seek and consume marine debris if other food is not available. In most cases, this debris passed through the gut within a few days, but latex was found to take up to four months to clear the intestinal system. While ingestion of marine debris has been linked to sea turtle mortalities, sublethal effects are more common (NRC 1990; McCauley and Bjorndal 1999).

Ordnance-Related Materials

Ordnance-related materials include non-explosive training rounds and shrapnel from explosive rounds. The solid materials of high metal content quickly sink through the water column to the sea floor where they could be available for ingestion by benthic foraging sea turtles. Ingestion of expended ordnance is not expected to occur in the water column because ordnance quickly sinks.

Leatherbacks feed throughout all zones of the water column (Davenport 1988; Eckert et al. 1989; Grant and Ferrell 1993; Salmon et al. 2004; James et al. 2005a). Prey is predominantly gelatinous zooplankton such as jellyfish and tunicates (NMFS and USFWS 1992; Grant and Ferrell 1993; Bjorndal 1997; James and Herman 2001; Salmon et al. 2004), and they typically do not feed in the benthic environment. Therefore, although leatherbacks could reach ordnance-related materials resting on the bottom at depths up to 1,000 meters, they are unlikely to ingest it.

Leatherbacks would not be expected to ingest ordnance expended under the No Action Alternative because they do not typically feed in the benthic environment. In accordance with the NEPA, expended materials in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from expended materials in non-territorial waters would be possible but unlikely. In accordance with the ESA, ordnance-related materials under the No Action Alternative would have no effect on leatherback sea turtles.

Target-Related Materials

At-sea targets used in the PACNW OPAREA range from high-technology, remotely operated airborne and surface targets (such as airborne drones) to low-technology, floating, at-sea targets (such as inflatable targets) and airborne, towed banners. Many of the targets are designed to be recovered for reuse and are not destroyed during training. The expendable targets used in the Study Area are the Expendable Mobile Antisubmarine Warfare Training Target (EMATT) and MK-58 Marine Marker. These units are two and three feet in length, respectively, and sink to the bottom intact. Because of these characteristics, they present no ingestion hazard to sea turtles.

MK-58 marine markers produce chemical flames and surface smoke. They are used in training exercises to mark a surface position to simulate divers, vessels, and points of contact on the surface of the ocean. The smoke dissipates in the air and has little effect on the marine environment. The marker burns similar to a flare, producing a flame until all burn components have been used. While the light generated from the marker is bright enough to be seen up to three miles (4.8 kilometers) away in ideal conditions, the light either reflects off the water's surface or enters the water and attenuates in brightness over depth. Because they spend only three to six percent of time on the sea surface, it would be extremely unlikely that sea turtles would be affected by the light from the marker.

In accordance with the NEPA, target use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from target use in non-territorial waters would be possible but unlikely. In accordance with the ESA, use of target-related materials under the No Action Alternative would have no effect on leatherback turtles.

Entanglement

Entanglement in persistent marine debris threatens the survival of sea turtles in the eastern Pacific Ocean (NMFS and USFWS 1998a). Often, turtles that become entangled in debris, usually abandoned fishing gear, cannot submerge to feed or surface to breathe. Those that do not starve or drown may lose a limb or attract predators with their struggling. Turtles also can become entangled in plastics and other buoyant and persistent synthetic debris discarded into the ocean (Balazs 1995; Carr 1987).

Military-related debris such as parachutes may be encountered by sea turtles in the waters of the PACNW OPAREA. Although entanglement in military-related debris was not cited as a source of injury or mortality for any sea turtle in a large stranding database for Californian waters, there is a potential for sea turtles to become entangled in expended materials.

The greatest risk of entanglement occurs when debris, primarily parachutes, is on or near the surface. Aircraft-launched sonobuoys, flares, torpedoes, and EMATTs deploy nylon parachutes of varying sizes (e.g., the surface area is 1.5 square feet (0.1 square meter) to 3.5 square feet (0.3 square meter)). At water impact, the parachute assembly is expended and sinks because all of the material is negatively buoyant. Some components are metallic and will sink rapidly.

Entanglement and the eventual drowning of a sea turtle in a parachute assembly would be unlikely because such an event would require the parachute to land directly on an animal, or the animal would have to swim into it before it sinks.

The expended material accumulates on the ocean floor and is covered by sediments over time, reducing the potential for entanglement. If bottom currents are present, the canopy may billow (bulge) and pose an entanglement threat to sea turtles with bottom-feeding habits. However, the probability of a sea turtle encountering a submerged parachute assembly and the potential for accidental entanglement in the canopy or suspension lines is low.

Under the No Action Alternative, one torpedo would be potentially be used each year during SINKEX activities. With the low density of turtles and the use of one torpedo, impacts from guide wires may affect sea turtles.

Under the No Action Alternative, approximately 9,200 parachutes would be deployed and not recovered. These parachutes would deliver sonobuoys, targets, and markers during training exercises. Assuming an even distribution of parachutes over the PACNW OPAREA, the concentration of material presenting a short-term entanglement hazards would be 0.075 pieces per nm^2 (3.4 km^2). Based on the potential occurrence of sea turtles (0.12 to 0.26 animals per nm^2 [3.4 km^2]) the number of sea turtles potential affected would be 0.009 to 0.0195 animals per year. Thus, the potential for sea turtle entanglement in Navy debris would be low.

In accordance with the NEPA, entanglement from military-related debris in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from entanglement from military-related debris in non-territorial waters would be possible but unlikely. In accordance with the ESA, entanglement from military-related debris under the No Action Alternative may affect leatherback sea turtles.

3.8.2.3 Alternative 1

Under Alternative 1, the level of activities in the PACNW OPAREA would increase relative to the No Action Alternative. In addition to accommodating training activities currently conducted, Alternative 1 would support an increase in training activities to include force structure changes associated with the introduction of new weapon systems, vessels, and aircraft into the Fleet. Baseline-training activities would be increased. In addition, training activities associated with force structure changes would be implemented.

Vessel Movements

As described for the No Action Alternative, the number of Navy vessels operating during training exercises would vary, but would continue to include an average of one vessel per activity. Under Alternative 1, steaming hours would increase four percent from current conditions. During a year of

training activities, 7,228 steaming hours would occur in the PACNW OPAREA. However, vessel movements would be widely dispersed throughout the area, with approximately 0.06 hours of steaming per nm^2 (3.4 km^2) annually.

The small increase in steaming hours would not measurably increase potential effects to sea turtles. Disturbance impacts to sea turtles from vessel movements and from general disturbance associated with passing Navy vessels under Alternative 1 would be the similar to those described for the No Action Alternative.

Sea turtles exposed to the general disturbance associated with a passing Navy vessel could exhibit a short-term behavioral response such as fleeing. In accordance with the NEPA, vessel movements in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would possible but unlikely. In accordance with the ESA, vessel disturbance under Alternative 1 may affect leatherback sea turtles.

Vessel Collisions

The types of vessel strike impacts to sea turtles under Alternative 1 would be the same as those described for the No Action Alternative. The four percent increase in steam hours would still produce approximately 0.06 hours of steaming per nm^2 (3.4 km^2) annually. The modest increase in steaming hours associated with this alternative would not measurably change effects on sea turtles relative to the No Action Alternative.

In accordance with the NEPA, vessel strikes in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would be possible but unlikely. In accordance with the ESA, vessel disturbance under Alternative 1 may affect leatherback sea turtles.

Aircraft Overflights

Under Alternative 1, 9,204 overflights would occur above the NWTRC annually. This would represent a 21 percent increase from No Action Alternative conditions. Of these overflights, 109 would be helicopter flights conducted primarily over land, a 13 percent increase from the No Action Alternative. Most of the remaining, non-helicopter overflights would occur over the PACNW OPAREA at elevations in excess of 3,000 feet (915 meters) and more than three nautical miles (5.5 km) from shore.

The 21 percent increase in potential exposure to visual and noise disturbance would result in similar effects to sea turtle behavior described for the No Action Alternative. Exposures to elevated noise levels associated with Alternative 1 would be brief and infrequent, based on the transitory, dispersed nature of the overflights. Sound exposure levels are relatively low because sea turtles spend only 3 to 6 percent of the time at the sea surface and most of the overflights would be above 3,000 feet (915 meters).

Sea turtles could exhibit no response, or may exhibit behavioral reactions such as quick diving. Any behavioral avoidance reaction would be short-term and would not permanently displace animals or result in physical harm. Overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed to low-altitude overflights.

In accordance with the NEPA, aircraft overflights in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would be possible but unlikely. In accordance with the ESA, aircraft overflights under the Alternative 1 may affect leatherback sea turtles

Non-Explosive Ordnance Use

Approximately 100,000 non-explosive ordnance rounds would be used in the PACNW OPAREA annually under Alternative 1 – a 16 percent increase from current conditions. As described for the No Action Alternative, use may be concentrated in W-237, but ordnance is used in all areas of the PACNW OPAREA beyond three nautical miles (5.5 km). The density of annual ordnance use would be approximately 0.8 items per nm^2 (3.4 km^2) over the range. Using the existing turtle density estimate of 0.12 to 0.26 turtles per nm^2 (3.4 km^2), and given the relatively small sizes of both the turtles (up to 70 inches [1.8 meters]) and the ordnance used (from less than one inch [2.5 centimeters] to 8 feet [2.4 meters]), the potential for direct ordnance strike of turtles is low. Consistent use of Navy protective measures would also help minimize the likelihood of ordnance strikes.

In accordance with the NEPA, non-explosive ordnance use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from non-explosive ordnance use in non-territorial waters would be possible but unlikely. In accordance with the ESA, non-explosive ordnance strikes under the Alternative 1 may affect leatherback sea turtles.

Underwater Detonations and Explosive Ordnance

Under the Alternative 1, approximately 73 bomb and missile explosions would occur each year during training activities in the PACNW OPAREA. In addition, 136 explosive sonobuoys would be used. As described for the No Action Alternative, use of these explosive training components would be concentrated in W-237, but they could be used in all areas of the PACNW OPAREA beyond three nautical miles (5.5 km). The occurrence density of annual ordnance use would be approximately 0.0017 detonations per nm^2 (3.4 km^2) over the entire PACNWOPAREA.

The leatherback sea turtle generally occurs in the offshore areas of the PACNW OPAREA, but they have been sited in Puget Sound. In the unusual event that a sea turtle were in the vicinity of underwater EOD activities, they could be exposed to the pressure wave from the detonation. With the low occurrence rate of leatherbacks in Puget Sound, the infrequency of EOD activities (four total detonations per year), and protective measures employed, impacts from underwater EOD may affect leatherbacks.

As described for the No Action Alternative, an explosive analysis was conducted to estimate the number of sea turtles that could be exposed to impacts from explosions (see Section 3.9 Marine Mammals for a full description of the modeling and methods and Section 3.8.2.1 for sea turtle-specific thresholds). The explosions and detonations that would take place under Alternative 1 would have the potential to affect four leatherback sea turtles – two would potentially be affected at the dual criteria level (23 psi peak pressure from small explosives) and two would potentially be affected at the non-injurous behavior disruption level. No sea turtle mortalities would be expected under Alternative 1. The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that unavoidable significant effects to sea turtles do not result from implementation of the proposed action.

In accordance with the NEPA, explosive ordnance use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from explosive ordnance use in non-territorial waters would be possible but unlikely. In accordance with the ESA, use of explosive ordnance in the PACNW OPAREA under Alternative 1 may affect leatherback turtles.

Expended Materials

Ordnance-Related Materials

As described for the No Action Alternative, leatherback sea turtles would not be expected to be at risk from ingesting ordnance-related materials because they feed in the water column, not in the benthic

environment. Because these materials sink rapidly and are encrusted on the sea floor, the potential to affect the leatherback would be remote.

Under current conditions, one torpedo would be potentially be used each year during SINKEX activities. Torpedoes may be deployed using guide wires to direct them to their target. As the torpedo leaves the launch tube a thin wire spins out, electronically linking the vessel and torpedo. This enables an operator to initially guide the torpedo toward the target. The wire is severed prior to detonation as the torpedo's guidance system takes over during the final phases of the attack. The thin wires are made of metal and sink to the bottom. With the low density of turtles and the use of one torpedo, impacts from guide wires may affect leatherbacks.

Leatherbacks would not be expected to ingest ordnance expended under Alternative 1 because they do not typically feed in the benthic environment. In accordance with the NEPA, expended materials in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from expended materials in non-territorial waters would be possible but unlikely. In accordance with the ESA, ordnance-related materials under the No Action Alternative would have no effect on leatherback sea turtles.

Target-Related Materials

As described for the No Action Alternative, a variety of at-sea targets are used in the PACNW OPAREA. Many of the targets are designed to be recovered for reuse and are not destroyed during training. The expendable EMATT and MK-58 units are two and three feet in length (0.6 to 0.9 meter) and sink to the bottom intact. Because of these characteristics, they present no ingestion hazard to sea turtles.

The smoke and flames produced by the MK-58 dissipate in the air, having little effect on the marine environment. While the light generated from the marker is bright enough to be seen up to three miles (4.8 kilometers) away in ideal conditions, the light either reflects off the water’s surface or enters the water and attenuates in brightness over depth.

In accordance with the NEPA, target use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from target use in non-territorial waters would be possible but unlikely. In accordance with the ESA, use of target-related materials Alternative 1 would have no effect on leatherback sea turtles.

Entanglement

Under Alternative 1, use of parachuted sonobuoys would increase by approximately three percent compared to the No Action Alternative. Changes in the use of targets and markers that are delivered using parachutes were provided under “Target-Related Materials.” As described for the No Action Alternative, the parachutes would not be recovered and would sink to the sea floor. The modest increase in the use of materials that could cause a short-term entanglement hazard would not measurably increase potential impacts to sea turtles above those described for the No Action Alternative.

Under Alternative 1, two torpedoes would be potentially be used each year during SINKEX activities. As described for the No Action Alternative, torpedoes may be guided by thin wires after initial deployment. These metal wires sever prior to detonation and sink to the bottom.

In accordance with the NEPA, entanglement from military-related debris in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from entanglement from military-related debris in non-territorial waters would be possible but unlikely. In accordance with the ESA, entanglement from military-related debris under Alternative 1 may affect leatherback turtles.

3.8.2.4 Alternative 2

Under Alternative 2, the level of activities in the PACNW OPAREA Study Area would increase relative to the No Action Alternative and Alternative 1. Implementation of this alternative would include all elements of Alternative 1 (accommodating training activities currently conducted, increasing training activities, and accommodating force structure changes). In addition, training activities of the types currently conducted would be increased and range enhancements would be implemented (as described in Section 2.5.2.). These range enhancements would lead to an increase in gunnery, missile, and electronic combat exercises.

Vessel Movements

As described for the other alternatives, the number of Navy vessels operating during training exercises would average one vessel per exercise. During a year of training activities, steaming hours would increase by 10 percent to 7,628 hours, relative to the No Action Alternative. Vessel movements would be widely dispersed throughout the PACNW OPAREA, with approximately 0.06 hours of steaming per nm^2 (3.4 km^2).

The modest increase in steaming hours would not measurably increase potential effects to sea turtles. Disturbance impacts to sea turtles from vessel movements under Alternative 2 would be similar to those described for the No Action Alternative and Alternative 1.

Sea turtles exposed to the general disturbance associated with a passing Navy vessel could exhibit a short-term behavioral response such as fleeing. In accordance with the NEPA, vessel movements in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would possible but unlikely. In accordance with the ESA, vessel disturbance under Alternative 2 may affect leatherback sea turtles.

Vessel Collisions

The types of vessel strikes effects to sea turtles under Alternative 2 would be the same as those described for the No Action Alternative. The 10 percent increase in steaming hours associated with this alternative would not measurably change effects on sea turtles relative to the No Action Alternative.

In accordance with the NEPA, vessel strikes in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in non-territorial waters would be possible but unlikely. In accordance with the ESA, vessel disturbance under Alternative 2 may affect leatherback sea turtles.

Aircraft Overflights

Under Alternative 2, 11,786 overflights would occur annually. This would be a 55 percent increase over the number of overflights in the No Action Alternative. As with the other alternatives, most overflights would occur over the PACNW OPAREA at elevations in excess of 3,000 feet (915 meters) and beyond three nautical miles (5.5 km).

The increase in potential exposure to visual and noise disturbance that would be associated with a 55 percent increase in overflights would not measurably increase effects to sea turtles. Sea turtles could exhibit no response, or may change their behavior to avoid the disturbance. Any behavioral avoidance reaction would be short-term and would not permanently displace animals or result in physical harm. Overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed to low-altitude overflights.

In accordance with the NEPA, aircraft overflights in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from vessel movements in

non-territorial waters would be possible but unlikely. In accordance with the ESA, aircraft overflights under Alternative 2 may affect leatherback sea turtles.

Non-Explosive Ordnance Use

Approximately 181,000 non-explosive ordnance rounds would be used in the PACNW OPAREA annually under Alternative 2. As described above, use could be concentrated in W-237, but ordnance would be used in all areas of the PACNW OPAREA beyond three nautical miles (5.5 km). The density of annual ordnance use would be approximately 1.5 items per nm^2 (3.4 km^2) over the entire PACNW OPAREA. Using the existing turtle density estimate, 0.12 to 0.26 turtles could occur per nm^2 (3.4 km^2) within the PACNW OPAREA. Given the relatively small sizes of both the turtles (up to 70 inches [1.8 meters]) and the ordnance used (from less than one inch [2.5 centimeters] to 8 feet [2.4 meters]), the potential for turtles to be struck by ordnance is low. Consistent use of Navy protective measures would also help minimize the likelihood of ordnance strikes to sea turtles.

In accordance with the NEPA, non-explosive ordnance use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from non-explosive ordnance use in non-territorial waters would be possible but unlikely. In accordance with the ESA, non-explosive ordnance strikes under Alternative 2 may affect leatherback turtles.

Underwater Detonations and Explosive Ordnance

Under the No Action Alternative, approximately 93 bomb and missile explosions would occur each year during training activities in the PACNW OPAREA. In addition, 149 explosive sonobuoys would be used. Although use of these explosive training components would be concentrated in W-237, their use may occur in all areas of the PACNW OPAREA beyond three nautical miles (5.5 km). The occurrence density of annual ordnance use would be approximately 0.002 detonations per nm^2 (3.4 km^2) over the entire PACNW OPAREA.

Leatherbacks have been sited in Puget Sound, and could potentially be exposed to the pressure wave from the EOD detonations. As described for Alternative 1, in the unusual event that a sea turtle were in the vicinity of underwater EOD activities, they could be exposed to the pressure wave from the detonation. With the low occurrence rate of leatherbacks in Puget Sound, the infrequency of EOD activities (four total detonations per year), and protective measures employed, impacts from underwater EOD may affect leatherback sea turtles.

As described above, an analysis was conducted to estimate the number of sea turtles that could be exposed to impacts from explosions (see Section 3.9 Marine Mammals for a full description of the modeling and methods and Section 3.8.2.1 for sea turtle-specific thresholds). The explosions and detonations that would take place under Alternative 2 would have the potential to affect six leatherback sea turtles – three would potentially be affected at the dual criteria level (23 psi peak pressure from small explosives) and three would potentially be affected at the non-injurous behavior disruption level. No sea turtle mortalities would be expected under Alternative 2. The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that unavoidable significant effects to sea turtles do not result from implementation of the proposed action.

In accordance with the NEPA, explosive ordnance use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from explosive ordnance use in non-territorial waters would be possible but unlikely. In accordance with the ESA, use of explosive ordnance in the PACNW OPAREA under Alternative 2 may affect leatherback sea turtles.

Expended Materials

Ordnance-Related Materials

As described above, leatherback sea turtles would not be expected to be at risk from ingesting ordnance-related materials because they feed in the water column, not in the benthic environment. Because these materials sink rapidly and are encrusted on the sea floor, the potential to affect the leatherback would be remote. Leatherbacks would not be expected to ingest ordnance expended under Alternative 2 because they do not typically feed in the benthic environment. In addition, there is no difference in SINKEX activities between Alternative 1 and 2.

In accordance with the NEPA, expended materials in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from expended materials in non-territorial waters would be possible but unlikely. In accordance with the ESA, ordnance-related materials under Alternative 2 would have no effect on leatherback sea turtles.

Target-Related Materials

As described above, a variety of at-sea targets are used in the PACNW OPAREA. Many of the targets are recovered for reuse and are not destroyed during training. The expendable EMATT and MK-58 units sink to the bottom intact. Because of these characteristics, they present no ingestion hazard to sea turtles.

The smoke and flames produced by the MK-58 dissipate in the air, having little effect on the marine environment. The light generated from the marker is either reflects off the water's surface or enters the water and attenuates in brightness over depth.

In accordance with the NEPA, target use in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from target use in non-territorial waters would be possible but unlikely. In accordance with the ESA, use of target-related materials under Alternative 2 would have no effect on leatherback sea turtles.

Entanglement

Under Alternative 2, use of sonobuoys would increase by approximately 6 percent compared to the No Action Alternative. Changes in the use of targets and markers that are delivered using parachutes were provided under "Target-Related Materials." As described for the No Action Alternative, the parachutes would not be recovered and would sink to the sea floor. The modest increase in the use of materials that could cause a short-term entanglement hazard would not increase potential impacts to sea turtles above those described for the No Action Alternative.

Under Alternative 2, two torpedoes would be potentially be used each year during SINKEX activities. As described above, torpedoes may be guided by thin wires after initial deployment. These metal wires sever prior to detonation and sink to the bottom. The use of two guide wires each year would have a low probability of affecting sea turtles in the PACNW OPAREA.

In accordance with the NEPA, entanglement from military-related debris in territorial waters would have minimal impact on leatherback turtles. In accordance with EO 12114, harm to leatherback turtles from entanglement from military-related debris in non-territorial waters would be possible but unlikely. In accordance with the ESA, entanglement from military-related debris under Alternative 2 may affect leatherback sea turtles.

3.8.3 Mitigation Measures

As discussed in Section 3.8.4, impacts to the leatherback sea turtle resulting from the alternatives proposed in the EIS/OEIS would be below thresholds that could adversely affect the continued presence

of this species in the NWTRC or their use of the Study Area. The current requirements and practices described in Chapter 5 would continue to be implemented, and no further mitigation measures would be needed to protect sea turtles in the NWTRC.

3.8.4 Summary of Effects by Alternative

There are no formal density studies for sea turtles in the PACNW OPAREA, but use of the area by sea turtles other than the leatherback is restricted by cold water temperatures. The low occurrence of turtles, limited number of stressors from Navy activities, and routine implementation by the Navy of protective measures combine to produce a low potential for effects to sea turtles under all the alternatives. Table 3.8-2 summarizes the effects of the alternatives.

Table 3.8-2: Summary Effects – Sea Turtles

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non-U.S. Territorial Waters)
No Action Alternative	• Activities would have temporary and spatially limited short-term impacts. • No long-term effects would occur. • No Action Alternative may affect Federally listed leatherback turtles.	• Activities would have temporary and spatially limited short-term impacts. • No long-term effects would occur. • No Action Alternative may affect Federally listed leatherback turtles.
Alternative 1	• Impacts generally the same as No Action Alternative. • Alternative 1 may affect Federally listed leatherback turtles.	• Impacts generally the same as No Action Alternative. • Alternative 1 may affect Federally listed leatherback turtles.
Alternative 2 (Preferred Alternative)	• Impacts generally the same as No Action Alternative. • Alternative 2 may affect Federally listed leatherback turtles.	• Impacts generally the same as No Action Alternative. • Alternative 2 may affect Federally listed leatherback turtles.

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