4 IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

This chapter presents a discussion of the potential impacts to the affected environments described in Chapter 3 that would result from the construction and operation of the USWTR at the four sites under consideration: Site A in the Jacksonville OPAREA; Site B in the Charleston OPAREA; Site C in the Cherry Point OPAREA; and Site D in the VACAPES OPAREA. Chapter 4 is organized in a manner similar to Chapter 3. Subchapters 4.1 through 4.7 address the environmental impacts corresponding to the affected environment discussed in Chapter 3.

Under the No Action Alternative for this proposed action, the Navy would not construct or operate an instrumented shallow water training ASW range on the East Coast. Although a No Action Alternative would not prevent the Navy from maintaining some level of ASW readiness, the No Action Alternative would be detrimental to validated, constructive replay of ASW training, which has a direct effect on meeting an emergent training need. This alternative represents existing conditions at the USWTR locations and is used as the baseline alternative against which the magnitude of impact of constructing and operating a shallow water ASW range is evaluated. Under the No Action Alternative to the proposed action, a USWTR would not be installed, and no impacts to physical conditions, cultural resources, landside resources, or coastal zones associated with range installation would occur.

Landside impacts and impacts in the U.S. territorial seas have been analyzed per the provisions of NEPA, which apply to major federal actions with effects that occur in U.S. territory. These sections have been italicized. The remainder of the analyses in this OEIS/EIS have been made per the provisions of EO 12114, which apply to major federal actions with potentially significant effects that occur outside U.S. territory, in the global commons, or within the jurisdiction of a non-participating foreign government.

4.1 Physical Environment

This subchapter presents a discussion of the potential impacts to the physical environment that would result from construction and operation of the USWTR. The impacts of constructing the USWTR would be short-term in nature and related to the placement of transducer nodes and cabling. Once installed, the transducer nodes and interconnect cable would not require regularly scheduled maintenance. In the event that either the transducer nodes or interconnect cable become damaged, it would be necessary to repair and/or replace the damaged portions. Impacts from any repair or replacement would be short-term in nature.

The impacts of operating the USWTR largely relate to the use of inert weapons and other devices (described in Table 2-2). Most weapons and devices used during training exercises would be
removed at the conclusion of the exercises. However, some training devices would be discarded at sea. This equipment can be broadly characterized for analysis purposes into the following groups:

- Items related to torpedo use, including control wire, ballast, rocket airframe, air-launch accessories, and parachutes
- Sensing devices such as XBTs and sonobuoys
- Acoustic device countermeasures
- Targets

There are several reasons why marine debris is left in the environment. Firstly, the ocean currents often carry expended materials away from the activity area; thus, identification and retrieval efforts are difficult, if not impossible, to conduct following an activity. Secondly, retrieval personnel are limited in the overall depth of their dives for safety reasons. For example, deep dives require the implementation of specialized equipment. The Professional Association of Diving Instructors (PADI) suggests that recreational divers should not exceed 40 m (130 ft) (PADI, 2006). Diving beyond these depths is considered technical diving, which typically requires one or more mandatory decompression stops during ascension (NOAA Ocean Explorer, 2008). The overall safety risks associated with technical dives and the equipment required to conduct these types of dives greatly restricts its implementation.

A retrieval effort could be conducted using an unmanned remotely operated vehicle (ROV), but this method is neither efficient nor practical. There are very few ROVs available to the Navy with the capability to complete this type of operation, especially in deep water (greater than 1,524 m [5,000 ft]). Due to the manpower and support required to operate an ROV and support vessel and retrieve objects from the ocean floor, this method would not be timely enough to accurately locate the debris, as the ocean currents would invariably scatter the debris.

Lastly, there is the possibility that retrieval operations would create additional disturbance (water turbidity, damage to the equipment during retrieval, etc.) to the environment.

4.1.1 Geology, Bathymetry, and Substrate

The following discussion on geology, bathymetry, and substrate applies to the four proposed sites, Sites A, B, C, and D, unless otherwise noted.

4.1.1.1 Range Instrumentation

Installation of the USWTR would entail the placement of approximately 300 transducer nodes in water depths ranging from 37 to 402 m (120 to 1,319 ft), over an approximately 1,717 km² (500
NM²) area. The total seafloor area covered by these components would be approximately 3,300 m² (31,700 ft²), representing approximately 0.0000001 percent of the area of the proposed USWTR.

As a worst-case scenario, the entire trunk and internode cables were assumed to be buried, although it is likely that the interconnect cable between each node would not be buried except possibly in the shallower portions of Sites B and C. The trunk cable connecting the range to the shore facilities would be buried (including within U.S. territory) to a depth of approximately 0.3 to 0.9 m (1 to 3 ft). The trunk cable would be buried in a trench from the CTF to the point landward of any features such as a road, canal, or dune. From that location, the trunk cable would be installed by directional drilling to a location about 1,000 m (3,000 ft) off shore. At that location out to the junction box, the trunk cable would be buried in a trench approximately 0.3 to 0.9 m (1 to 3 ft) deep.

Ocean-bottom burial equipment would be used to cut (hard bottom) or plow (soft sediment) a furrow approximately 10 cm (4 in) wide, in which the 5.8 cm (2.3 in) diameter cable would be placed. The path of the burial equipment would have an impact on the surficial sediments and/or substrate. The path of the buried trunk is expected to be approximately 5 m (16 ft) wide, resulting in an approximately 920,000 m² (8,841,200 ft²) area of impact and burial of the internode cables would result in an additional 5,550,000 m² (59,739,700 ft²) area of impact. The combined area of impact of burial of the trunk and burial of the internode cables represents approximately 0.0002 percent of the area of the proposed USWTR. Hard bottom ledges and biogenic reef mounds are unlikely to be impacted, due to the difficulty of using burial equipment in these areas.

The cable installation would temporarily displace some bottom sediments or require cutting a trench in hard bottom, which would temporarily increase local sedimentation rates as the material removed from the trench returned to the sea floor. Expected turbidity plumes typically would last for a few hours and occur in the area near the ocean bottom. Without currents, the effects would be confined to the immediate vicinity of the cable, i.e. within about 10 m (33 ft) from the trench. Water currents would distribute the plume over a larger area but also dilute it.

Once cables are in place no additional disruption would be anticipated. In the event that either the transducer nodes or interconnect cable become damaged, it would be necessary to repair and/or replace the damaged portions, which would result in minor, short-term impacts to the sea floor.

The transducer nodes would be designed to remain fixed after installation such that they could not be moved by fishing gear. The impact of each node would be confined to the area of the ocean bottom where each rests. Each node would cover approximately 5 m² (50 ft²) of ocean bottom. During deployment of the nodes, they would settle slowly with ample time for mobile creatures to avoid being trapped under the node.
If transducer nodes or the trenched cable were to be installed on lime outcrops covered with live deep-water corals, the nodes may cause permanent localized damage to the live deep-water corals at the proposed USWTR Sites A, B, and C (live deep-water corals and other bottom features are not found or are not currently mapped at Site D). Growth rates of branching deep-water coral species, such as *Lophelia* and *Oculina*, are relatively low, ranging from about 1.0 to 2.5 cm/yr (0.4 to 1 in/yr) (NOAA, 2007c). In contrast, growth rates of branching shallow-water corals, such as *Acropora*, may exceed 10 to 20 cm/yr (4 to 10 in/yr). Damage to deep-water corals would be limited to the immediate location of the transducer node and internode cable, including the path of the cable burial vehicle. The area of the trench would likely not be recolonized by corals for decades to centuries (Freiwald et al., 2004). Areas temporarily disturbed by the tracks of the trenching machine (5 m [16 ft] in width) would become recolonized by local coral and invertebrate species. The deep-water corals in the Jacksonville, Charleston, and Cherry Point OPAREAs occur in scattered locations, potentially including locations in USWTR Sites A, B, and C. Potential impacts to these live deep-water corals are presented in Subchapter 4.2, under the EFH discussion.

**4.1.1.2 Exercise Torpedoes**

REXTORPs comprise 90% of the torpedoes to be used on the USWTR. The remaining 10% are EXTORPs. By procedure, the Navy recovers all exercise torpedoes (REXTORPs and EXTORPs). However, various accessories, as described below, are expended during the launch, operation, and recovery of EXTORPs. All of these expended materials would sink to the bottom. The expended materials may result in short-term localized impacts, but are unlikely to result in any significant long-term environmental impacts to the sea floor. Expended materials would sink into a soft bottom or would lie on a hard bottom, where (in the short term) they may provide a substrate for benthic colonization and may be covered eventually by shifting sediments or a mobile sand sheet. Over a period of years, non-inert debris (defined as all parts of a device that are made of readily degradable materials) would degrade, corrode, and become incorporated into the sediments. Rates of deterioration would vary, depending on material and conditions in the immediate marine and benthic environment.

Some expended materials or their components will not readily degrade based on the materials used to construct them. Such inert debris, defined as all parts of a device that are made of nonreactive materials, includes parts made of steel or aluminum, polymers (e.g., nylon, rubber, vinyl, and various other plastics), glass fiber, and concrete. While these items represent persistent seabed debris, their strong resistance to degradation and their chemical composition mean that there would be minimal leaching of heavy metals or organic compounds into the surrounding environment. As one of its environmental readiness requirements and goals, the Navy aims to minimize the use of toxic and hazardous materials and chemicals that pose the greatest environmental risks (DoN, 2008c). Once incorporated into the surrounding environment, removal of inert materials may result in greater damage than improvement. Cumulative impacts of these materials are expected to be minimal based on the limited number of torpedoes that would be used over a wide area.
For purposes of this analysis, the following types of torpedoes were considered:

- The Mk 48/ADCAP, a heavyweight EXTORP, is equipped with a single-strand control wire, which is laid behind the torpedo as it moves through the water. At the end of a torpedo run, the control wire would be released from the firing vessel and the torpedo to enable recovery of the torpedo. The wire would sink rapidly and settle on the ocean floor, stretched into a long single line, as opposed to being looped or in tangles. The guidance wire is a very fine thin-gauge copper wire. The Mk 48 torpedo also uses a flex hose to protect the control wire.

The 76.2 m (250 ft) long flex hose would be expended into the ocean after completion of the torpedo run and, because of its weight, would sink rapidly to the bottom. Two types of flex hose are used: the strong flex hose (SFH) and the improved flex hose (IFH). The IFH is replacing the SFH in accordance with a phased schedule. Each year, about 48 Mk 48 EXTORPs would be used on the USWTR and, therefore, about 48 control wires and 48 flex hoses (SFHs or IFHs) would be expended annually. As the control wires and flex hoses will not easily loop or tangle, these materials are unlikely to result in the entanglement of any sea turtles, whales, or other animals that may encounter them on the sea bottom or in the water column.

- An assortment of air launch accessories, all of which consist of non-hazardous materials, would be expended into the marine environment during air launching of Mk 46 and Mk 54 torpedoes, which are lightweight torpedoes. Depending on the type of launch craft used, Mk 46 launch accessories may be comprised of a protective nose cover, suspension bands, air stabilizer, release wire, and propeller baffle (DoN, 1996a). When used in the VLA configuration, the Mk 46 may have a nose cap. Mk 54 air launch accessories may be comprised of a nose cap, suspension bands, air stabilizer, sway brace pad, arming wire, and fahnstock clip (DoN, 1996a). The Mk 46 is expected to remain in the Navy inventory until 2014, and the rate of use of the Mk 46 will decrease as Mk 54 ramps up. It is not known what portion of the estimated 330 torpedoes to be used annually on the USWTR would be air launched and, therefore, what quantity of air launch accessories would be expended.

- The VLA is a vertically launched rocket that carries a Mk 46 torpedo as payload. The components discharged into the water during the ballistic missile flight and water entry are the rocket motor, airframe, nose cap, parachute, and two lead weights from the EXTORP. The Mk 46 is expected to be on VLA missiles until 2017, at which time it will be replaced by the Mk 54. There are no lead weights associated with the Mk 54 EXTORP. An estimated ten launches of the VLA would occur per year on the USWTR.
An estimated 160 of the approximately 330 lightweight torpedoes used on the USWTR would be Mk 46s, and an estimated 16 of these would be EXTORPs. Upon completion of a Mk 46 EXTORP run, two steel-jacketed lead ballast weights are released to lighten the torpedo, allowing it to rise to the surface for recovery. Each ballast weighs 16.8 kg (37 lbs) and sinks rapidly to the bottom. Therefore, approximately 32 16.8 kg (37 lb) ballasts would be expended annually, totaling 537 kg (1,184 lbs) of lead ballast. In addition to the ballasted Mk 46 EXTORPs, Mk 46 REXTORPs launched from P-3s also must be ballasted for safety purposes. Ballast weights for these REXTORPs are similarly released to allow for missile recovery. Ballasting the Mk 46 REX TORP for P-3 use requires six ballasts, totaling 82 kg (180 lbs) of lead. It is estimated that a maximum of 51 Mk 46 REXTORPs would be launched by P-3s, resulting in the expenditure of 4,164 kg (9,180 lbs) of lead ballast. There are no lead weights involved in the Mk 54 EXTORP or the REX TORP currently being designed.

U.S. Navy exercise torpedoes are designed with safety features to allow their use against manned submarines as targets during training. For a detected target in an exercise, such as a U.S. Navy submarine, the exercise torpedo terminates homing and turns away from the target before reaching impact. This safety feature protects both the manned submarine target and allows the exercise torpedo to be undamaged and available for reuse. The Navy expends considerable effort to recover each exercise torpedo and they are reused for training many times.

**4.1.1.3 Sensing Devices, Countermeasures, and Targets**

**Sensing Devices and Countermeasures**

Devices expended on the range would comprise XBTs, sonobuoys, and ADCs, all of which are expected to sink to the sea floor. Other devices deployed in the USWTR, such as sonars and dipping sonars, and recoverable sea gliders would not be expended.

It is estimated that 132 XBTs, 3,000 sonobuoys, and 33 ADCs per year would be used during training exercises. Because of the large number of sonobuoys that would be left in place annually in the USWTR, the potential for these devices to impact the physical environment of the sea floor was analyzed as follows.

The maximum seafloor area covered by sonobuoys settling on the bottom was estimated by multiplying the typical length of a sonobuoy (91 cm [36 in]) by the diameter (12.5 cm [4.9 in]) to obtain a footprint of 1,138 cm² (176 in²), or 0.11 m² (1.2 ft²). This number, multiplied by 3,000 (the estimated number of sonobuoys used per year), provides an estimated overall sonobuoy coverage of 341 m² (3,673 ft²). As the sea floor of the USWTR would encompass an area of 1,713 km² (500 NM²), the total coverage of the USWTR by sonobuoys would be less than 0.00002% of the USWTR sea floor annually.
The sonobuoys, as well as other devices left in place in the USWTR, would degrade, corrode, and become incorporated into the sediments over time. An extensive study was conducted in Canada (Environmental Sciences Group, 2005) at Canadian Forces Maritime Experimental and Test Ranges near Nanoose, British Columbia. As a result of range operations from 1965 to 2004, 2,769 metric tonnes (3,052 tons) of debris have been deposited on the sea floor. The study found that range operations and the resulting deposition of debris have not significantly altered the physical state of the sea floor. The study concluded that in general, the direct impact of debris accumulation on the sea floor appeared to be minimal, having no detectable effects on wildlife or sediment quality. The limited amount of debris deposited on the sea floor each year will be left there, as the benefits of retrieval are apt to be outweighed by the potential habitat damage associated with the retrieval.

Another study was conducted to determine whether the operation of the Dabob Bay Range Complex in Washington State has had an adverse effect on sediment and water quality (DoN, 2001c). Concentrations of six metals – cadmium, copper, lithium, lead, zinc, and zirconium – in Dabob Bay sediment and water were compared with those in similar samples from other locations and with environmental standards. The study concluded that, although the range has been in operation for many decades, these six metals that could have been released by past range activities are not elevated in the range.

Residual metals associated with scuttled sonobuoys on the ocean floor represent a potential source of contamination to sediments. However, none of the studies to date have found elevated concentrations of metals in the vicinity of batteries, as described below.

A recent battery study involved a comprehensive survey of 775 aquatic Aid to Navigation (AtoN) sites in California. After finding only 37 stations with expended batteries, the U.S. Coast Guard (USCG) selected eight locations to represent potentially impaired habitats. Ten site sediment samples and a minimum of four background sediment samples were generally collected at each AtoN location. The sediment samples were collected from a depth of 0 to 10 cm (0 to 4 in) and adjacent to or within 15 m (50 ft) of each battery location. Sediments were analyzed for all metal constituents in the subject batteries. Concentrations of metals in sediments were either below NOAA screening levels or consistent with background levels for all but two sites. At one site, copper levels were elevated; at the other site, mercury and cadmium were elevated. A repeat survey at the high-mercury site failed to detect concentrations above NOAA screening levels. Because the statistical analysis in the sampling strategy targeted the locations representing the worst-case scenario, it was determined that, while batteries may contribute risks at these two sites, no further investigation was required. This study did yield data where lead concentrations were between the NOAA effects range low (ERL) and effects range median (ERM), but all levels of lead were less than the levels from reference AtoN sites without battery power. Neither of the AtoN studies included evaluations of factors that mediate risks; hence, both present very conservative assessments. Factors that are generally understood to reduce risks associated with contaminated sediments include acid-volatile sulfide concentrations and organic carbon; both act to reduce the bioavailability of metals (USEPA, 2001).
An earlier battery study for mostly zinc-mercury batteries was conducted with similar findings. USCG conducted research to determine the environmental effects associated with discharged AtoN batteries that contained a 500 g (17.6 oz) zinc electrode coated with approximately 20 g (0.7 oz) of elemental mercury (Borener and Maugham, 1998). Among other items, their research included conducting environmental assessments for prototypical AtoN disposal sites in the Chesapeake Bay, Tampa Bay, Tennessee River, Puget Sound, and Midway Island. The field studies at each location included analytical data for 10 samples per AtoN station, with each sample representing 126 m² (1356 ft²) for all the prototype investigations except Midway Island. At Midway Island, analytical data from 27 samples per AtoN station were taken, with each sample representing 46 m² (495 ft²). Bioaccumulation data were also obtained, generally from sessile (permanently attached) organisms on the batteries.

While the results of the prototype investigations varied by location, some common trends were noted. A full description of each study is available in individual reports for each prototype investigation. In general, the extremely low percentage of methylmercury, and thus low risk potential, was common at all of the characteristic aquatic environments examined. Very low mercury concentrations were detected in the aquatic organisms, even those attached to batteries. These findings indicate no significant risk to human health or the aquatic food chain. The limited spatial distribution of mercury within the sediment was another common pattern detected during the prototype program. In most cases, elevated sediment concentrations, if any, were confined to the immediate vicinity (less than 1 m [3 ft]) of batteries, and in all cases, if there were any slightly elevated concentrations detected beyond 1 m (3 ft), the condition was limited to 10 m (33 ft) or less from the AtoN. In almost all cases, even the highest mercury concentrations measured around AtoNs was within the range of background concentrations measured as part of the investigation or reported in the literature for the general prototype investigation area.

Borener and Maugham (1998) concluded that there was no correlation between the measurement of metals in sediments in Chesapeake Bay, Tennessee River, Puget Sound, and Midway Island and proximity to batteries. In Tampa Bay, there was a high density of discarded batteries and broken batteries. It was determined that when both of these conditions occur, the sediment levels approach and in some cases even exceed levels associated with adverse effects on sediment dwelling organisms. However, even in the areas of highest battery concentrations and greatest percentage of broken batteries, methylmercury concentrations and levels in aquatic organisms are well below those that pose a potential risk to humans or the aquatic food chain.

Additionally, in the Chesapeake Bay Field Study, sediment and biological sampling was conducted at five locations as part of the prototype investigation program. The results of these investigations revealed a pattern which indicates little, if any, detectable risk due to spent primary AtoN batteries. For example, the Pooles Island Light, examined as part of the Chesapeake Prototype investigation, exhibited a combination of characteristics that could result in environmental risk. The habitat around Pooles Island Light is abundant with fish, crabs, and other marine organisms that could accumulate mercury. Discarding batteries onto the rip rap (e.g., large rocks used to inhibit erosion) at the base of the light resulted in a large number of broken batteries, and the oyster bar substrate could prevent mixing of the mercury from the
batteries into the sediment. The result could be relatively high concentrations of mercury at the sediment interface. However, investigations at the site revealed a pattern of association of mercury levels that correlated with the sediment type, not with the presence of batteries. The lack of any evidence of mercury risk due to batteries at this type of site supports the conclusion that batteries pose a very small risk to the aquatic environment in general (Borener and Maugham, 1998).

A USCG document entitled “Aids to Navigation (AtoN) Battery Release Reporting Requirements” found that lead and other metals from batteries associated with AtoN sites represented levels that were less than reportable quantities under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 103(a) (USCG, 1994). Since sonobuoy batteries are smaller and retain little metal after use, no reportable quantities should be present in seafloor deposits.

Furthermore, an update to the 1996 Environmental Assessment for the Canadian Forces Maritime Experimental and Test Ranges (CFMETR) near Nanoose, British Columbia, was completed in 2005 by Environmental Sciences Group, Royal Military College of Canada. This document analyzed chemical effects associated with expendable components from activities involving sonobuoys, torpedoes, EMATTs, and ADCs (ESG, 2005). Specifically, the analysis focused on lead, copper, lithium, and Otto fuel. The document stated that metal contaminants were most likely to concentrate in fine-grained particulate matter, especially when smaller than 63 μm. The findings of the EA demonstrated that CFMETR operations did not cause a measurable effect on sediment quality (ESG, 2005).

Given the mobility characteristics for the most soluble battery constituent, lead chloride, and the extensive studies conducted by the USCG, there is low potential for substantial accumulation of contaminant in sediments. Therefore, there would be no significant impact to sediments from sonobuoy batteries in territorial waters under the No Action Alternative, or at Sites A, B, C, or D. In addition, there would be no significant impact to sediments from sonobuoy batteries in non-territorial waters.

**Targets**

Mk 30 target simulators would be fully recovered at the end of each run and would not be expended in the USWTR. Expendable mobile acoustic torpedo targets (EMATTs) would scuttle themselves and sink to the sea floor to be left in place. Typically, an estimated 50 EMATTs would be used in a year. The expended EMATTs are unlikely to result in any physical impacts to the sea floor. Expended EMATTs would sink into a soft bottom or would lie on a hard bottom, where they may provide a substrate for benthic colonization and may be covered eventually by shifting sediments. Over a period of years, the EMATTs would degrade, corrode, and become incorporated into the sediments.
4.1.2 Water Characteristics and Currents

Water characteristics and current impacts are considered to be the same for the four proposed USWTR sites, Sites A, B, C, and D; therefore, the impacts for the four areas are considered together.

With respect specifically to construction impacts, there are expected to be minimal, short-term impacts to water quality. During installation of the cable and transducer nodes, bottom sediments would be disturbed, which would result in a temporary increase in turbidity. Although increases in suspended material in the water column could potentially affect eggs and larvae of demersal and pelagic fish species in areas directly adjacent to construction areas, these effects would be temporary and the increased turbidity would not pose a significant impact, given its limited duration.

4.1.2.1 Range Instrumentation

No long-term impacts to the water quality and currents are expected as the result of installation of the USWTR at any of the proposed sites. As discussed in subchapter 2.2.1, construction of range instrumentation would take place in three increments that would occur over a projected nine-year period, so that the limited short-term increases in turbidity discussed in the preceding paragraph would be localized and spaced out over time.

There is very little scientific information on the actual environmental impacts of seafloor cables, including their installation and subsequent maintenance, repair, and final disposition. Current Navy and industry practice is to leave in place out-of-service seafloor cables. One issue associated with this practice is the potential for chemical leaching from cable constituents into surrounding media. The outer layers of submarine cables are insoluble and inert, at least in the short term, and readily become encrusted with marine organisms. Inner metallic components are sealed off from the surrounding media, at least while the cable is intact, although the cutting or abrasion of cables can expose the inner metallic components to corrosion (e.g., Kogan et al., 2003). Cables disposed at permitted artificial reef sites off Maryland support an abundance of fishes and invertebrates without any apparent harmful effects or issues regarding the internal constituents of the cables (Ocean City Reef Foundation, 2004).

4.1.2.2 Exercise Torpedoes

Water quality impacts that may result from the use of torpedoes can be grouped by their origin; that is, impacts attributable to propulsion systems, to other chemical releases, or to expended accessories (DoN, 1996a,b). For the purpose of the analysis of the water quality impacts associated with EXTORPs, the following discussion is organized by the origin of the water quality impacts so that EXTORPs with common propulsion systems are discussed as a group, as are EXTORPs with non-propulsion system chemical releases and expended accessories in common.
Propulsion Systems

Mk 46, Mk 54, and Mk 48 Torpedoes

OTTO Fuel II propulsion systems are used in the Mk 46, Mk 54, and the Mk 48 torpedoes. There have been over 5,800 exercise test runs of the Mk 46 torpedo between FY 89 and FY 96 (DoN, 1996a), and approximately 30,000 exercise test runs of the Mk 48 torpedo over the last 25 years (DoN, 1996b). Navy studies conducted at torpedo test ranges that have lower flushing rates than the open sea did not detect residual OTTO Fuel II in the marine environment (DoN, 1996a, b).

It is unlikely that OTTO Fuel II contained in a test torpedo would be released into the marine environment. Under the worst-case scenario of a catastrophic failure, however, up to 27 kg (59 lbs) of OTTO Fuel II could be released from a Mk 46 or Mk 54, or up to 152 to 203 kg (335 to 448 lbs) from a Mk 48 torpedo (DoN, 1996a, b). While OTTO Fuel II levels generally should not exceed 0.5 mg/L to prevent toxicity to marine organisms (DiSalvo et al., 1976), it is anticipated that even in the event of such a maximum potential spill, no long-term adverse impacts to the marine environment would result, because:

- The water volume and depth of the USWTR would rapidly dilute the spill.
- Five types of common marine bacteria (*Pseudomonas*, *Flavobacterium*, *Vibrio*, *Achromobacter*, and *Arthrobacter*) that exist at all sites have been identified that attack and ultimately break down OTTO fuel (DoN, 1996a, b).

Otto Fuel II is combusted in the torpedo engine and the combustion byproducts are exhausted into the torpedo wake, which is extremely turbulent and causes rapid mixing and diffusion. The exhaust products of the combustion of OTTO Fuel II are nitrogen oxides (NO\(_x\)), carbon monoxide (CO), carbon dioxide (CO\(_2\)), hydrogen (H\(_2\)), nitrogen (N\(_2\)), methane (CH\(_4\)), ammonia (NH\(_3\)), and hydrogen cyanide (HCN) (DoN, 1996a,b). These combustion products are exhausted to the sea, where they are dissolved, disassociated, or dispersed in the water column.

Hydrogen cyanide does not normally occur in seawater and, if in high enough concentration, could pose a potential risk to both humans and marine biota. The USEPA national recommendation for cyanide in marine waters is 1 μg/L, or approximately 1 part per billion (ppb), for both acute and chronic criteria (USEPA, 2006).

Mk 46 and Mk 54 torpedoes are expected to discharge hydrogen cyanide concentrations of 280 ppb, and Mk 48 torpedoes are expected to discharge hydrogen cyanide concentrations ranging from 140 to 150 ppb (DoN, 1996a, b). These initial concentrations are well above the USEPA recommendations for cyanide. However, because it has extremely high solubility in seawater, hydrogen cyanide would diffuse to levels below 1 μg/L within 5.4 m (17.7 ft) of the center of the torpedo’s path, and thus should pose no threat to marine organisms. During an estimated 161 exercises per year, on some days approximately four to six non-explosive Mk 46 or Mk 54 EXTORPs per day may be used on the USWTR (see Subchapter 2.1.2). As these launches would
occur over a 24 hour period and are unlikely to be conducted in the same area within the 1,717 km² (500 NM²) USWTR, no significant environmental effects are expected.

The other exhaust products are not of concern because:

- Most OTTO Fuel II combustion products, specifically carbon dioxide, water (H₂O), nitrogen, methane, and ammonia, are naturally occurring in seawater.

- Several of the combustion products are bioactive. Nitrogen is converted into nitrogen compounds through fixation by certain blue-green algae, providing nitrogen sources and essential micronutrients for marine phytoplankton. Carbon dioxide and methane are integral parts of the carbon cycle in the oceans and are taken up by many marine organisms.

- Carbon monoxide and hydrogen have low solubility in seawater and excess gases will bubble to the surface.

- Although trace amounts of nitrogen oxides may be present, they are usually below detectable limits. In low concentrations, nitrogen oxides are not harmful to marine organisms and are a micronutrient source of nitrogen for aquatic plant life.

### Chemical Releases

#### Mk 46, Mk 54, and Mk 48 Torpedoes

Mk 46, Mk 54, and Mk 48 torpedoes contain potentially hazardous or harmful (non-propulsion-related) components and materials. Only very small quantities of these materials, however, are contained in each torpedo. During normal exercise operations, the torpedo is sealed and is recovered at the end of a run; therefore, none of the potentially hazardous or harmful materials would be released to the marine environment.

Potentially hazardous or harmful materials could be released on impact with a target or the sea floor. However, since the guidance system of the torpedo is programmed for target and bottom avoidance, the chance of an accidental release is remote. Further, since the amounts of potentially hazardous and harmful materials contained in each torpedo are very small, upon accidental release the materials would rapidly diffuse in the water column.

### Expended Accessories

#### Mk 48 Torpedo

The Mk 48 is equipped with a single-strand control wire, which is expended at the end of a torpedo run. The wire would sink rapidly and settle on the ocean floor. Although the wire is not likely to deteriorate rapidly or be destroyed by corrosion, microorganisms, or abrasion because
polyolefin coating protects it, it contains no lead or other materials that may pose a threat to the marine environment.

The Mk 48 torpedo uses either an SFH or IFH. The IFH is a multi-component design that consists of a stainless-steel spring overlaid with a polyester braid and then a layer of lead tape (DoN, 1996b). The entire assembly is then overlaid with a stainless-steel wire braid (DoN, 1996b). The SFH is constructed primarily of stainless steel and contains no lead or other materials that may pose a threat to the marine environment (DoN, 1996b).

The IFH contains 24 kg (53 lbs) of metallic lead. The potential of the release of lead into the ocean bottom environment immediately surrounding the IFH having adverse effects on pelagic and benthic organisms was analyzed. Benthic marine organisms that are near the IFH may be exposed to low concentrations of lead slowly released over time from the IFH. In marine biota, lead residues are generally highest near sources (e.g., disposal sites, dredging sites, mining areas), but no significant biomagnification of lead occurs in aquatic food chains (Eisler, 1988). Although elevated concentrations of lead were observed in the livers of marine mammals in an apparent “hot spot” for lead concentrations in the Irish Sea (Law et al., 1991), lead does not biomagnify in the food chain, as the highest concentrations are found in invertebrates that are eaten by fish, seabirds, and marine mammals (Johansen, 1997). In a study of the relationships between metals and marine food-web constituents in the Gulf of the Farallones National Marine Sanctuary in central California, Sydeman and Jarman (1998) found a significant decline in lead levels between krill and Steller sea lions, indicating biodepletion of lead rather than its biomagnification.

Corrosion studies conducted on lead in seawater have shown that lead corrodes at a rate of 0.8 mils (0.0008 in) per year (DoN, 1996b). It would take approximately 27 years for the 43 mm (0.043 in) thick lead in an IFH to fully disperse into the marine environment, at a rate of approximately 0.89 kg (1.96 lbs) per year (DoN, 1996b). However, as only 13 percent of lead is estimated to be soluble in seawater (Kennish, 2001) and some of that lead is likely to adsorb to sediments, the actual concentration of lead in seawater is likely to be much lower.

The Navy estimated the release of lead to the marine environment from the corrosion of the IFH based on a worst-case scenario, assuming low pH and high oxidation levels (Eh), no sedimentation, no marine growth or oxide buildup on the IFH, and no current or water movement (DoN, 1996b). The USEPA national recommended water quality criteria for lead in marine waters are 210 μg/L, or approximately 210 ppb, for acute exposure and 8.1 μg/L for chronic exposure (USEPA, 2006). Adverse effects from lead exposure are most pronounced at elevated water temperatures and reduced pH, in comparatively soft waters, in younger life stages, and after long exposures (Eisler, 1988). Based on this worst-case scenario, the Navy determined that the maximum distance from the IFH in which the average concentration of lead in seawater may be toxic to marine life would be 15.6 cm (6.1 in) (DoN, 1996b). Organisms that are within this distance of the IFH may be exposed to short-term lead levels that are above the USEPA acute toxicity water quality criteria for seawater aquatic life, which is 0.210 parts per million (ppm).
On the ocean bottom in the USWTR, however, the reaction of the IFH with the marine environment would be retarded because the usual bottom conditions are slightly basic, with a lower pH and lower temperature. Over time the cable would be increasingly less exposed to the full marine environment because of sedimentation, marine growth, and oxide coatings. It is reasonable to expect, therefore, that the actual average amount of lead released into seawater would be substantially less than this study predicts, and the lead that is released would be dispersed at a much higher rate than predicted.

The increased lead concentration predicted over the operational life of USWTR is insignificant as compared to background concentrations of lead which enter the oceans through the atmosphere and from other sources (Weiss et al., 1999). Because the low amounts of lead released to the marine environment are below concentrations that could adversely affect marine life, the lead contained in the IFH would pose no environmental threat to marine mammals, threatened/endangered species, or the marine environment, inclusive of fish and invertebrates.

**Mk 46 EXTORPs and REXTORPs**

An estimated 160 of the approximately 330 lightweight torpedoes used on the USWTR would be Mk 46s, and an estimated 16 of these would be EXTORPs. Upon completion of a Mk 46 EXTORP run, two steel-jacketed lead ballast weights are released to lighten the torpedo, allowing it to rise to the surface for recovery. Each ballast weighs 16.8 kg (37 lbs) and sinks rapidly to the bottom. Therefore, approximately 32 16.8-kg (37-lb) ballasts would be expended annually, totaling 537 kg (1,184 lbs) of steel-jacketed lead ballast. In addition to the ballasted Mk 46 EXTORPs, Mk 46 REXTORPs launched from P-3s also must be ballasted for safety purposes. Ballast weights for these REXTORPs are similarly released to allow for missile recovery. Ballasting the Mk 46 REXTORP for P-3 use requires six ballasts, totaling 82 kg (180 lbs) of lead. It is estimated that a maximum of 51 Mk 46 EXTORPs would be launched by P-3s, resulting in the expenditure of 4,164 kg (9,180 lbs) of lead ballast. In areas of soft bottom, ballasts would be buried quickly in the sediments.

The metallic lead of the ballast weights is unlikely to mobilize into the sediment or water as lead ions for three reasons. First, the lead is jacketed with steel, which means that the surface of the lead would not be exposed directly to the actions of seawater. Second, even if the lead were exposed, the general bottom conditions of slightly basic and low oxygen content (i.e., a reducing environment) would prohibit the lead from ionizing. In addition, only a small percentage of lead is soluble in seawater. Finally, in soft-bottom areas, the lead weights would be buried due to the velocity of their impact with the bottom. Sediments are generally anoxic and thus no lead would be ionized (DoN, 1996a). Studies at other ranges have shown the impact of lead ballasts to be minimal, as they are buried deep in sediments where they are not biologically available (Environmental Sciences Group, 2005). There would be no cumulative effects from the lead ballasts due to the low probability of mobilization. In addition, the likelihood of localized effects is miniscule, as any of the lead released into the water would likely be well below background concentrations in seawater of 0.02 to 0.4 μg/L (Kennish, 2001).
4.1.2.3 Sensing Devices, Countermeasures, and Targets

Sensing Devices

As stated previously, it is estimated that 132 XBTs and 3,000 sonobuoys per year would be used during training exercises and would be expended at sea. Expendable bathythermographs do not use batteries and do not contain any potentially hazardous materials. Because of the large number of sonobuoys that would be left in place annually in the USWTR and their use of seawater batteries, the potential for these devices to impact water quality was analyzed. SSQ-36B sonobuoys also use lithium batteries. However, because these batteries are very small – comparable in size to the wafer batteries used in wrist watches – the potential for their constituents to impact water quality is negligible.

The three main types of seawater batteries used in standard sonobuoys are classified according to the type of cathode used: lead chloride, cuprous thiocyanate, or silver chloride (DoN, 1993). The chemical constituents of potential concern for each of these batteries are lead, copper, and silver, respectively.

To evaluate the effect on water quality of metals released during operation of the sonobuoy seawater batteries, a model was developed to estimate the amount of metal released into the surrounding marine environment (DoN, 1993). The emission rates were then compared to federal metals limitations, as shown below. The model employed the following conservative assumptions:

- The solubility constants used were for metals in fresh water at 20°C (68°F). The average annual temperature at depth of sites evaluated in this report are lower than 20°C (68°F) and therefore would have lower solubility constants than used, as solubility tends to increase with temperature. Likewise, the solubility of most forms of lead is greater in fresh water than salt water due to the lower level of saturation.

- The entire seawater battery activation process would take place within a cube of 1 m (39 in) per side, containing a seawater volume of 1,000 L (264 gallons [gal]). Using the assumption of an enclosed area, concentrations are calculated to be much higher than actual conditions.

- No vertical turbulence would occur at the ocean bottom. This assumption is conservative, as there is known turbulence on the sea floor.

- Using the assumed horizontal flow rate of 5 cm (2 in) per second, the entire column of water would be replaced within 20 seconds.
The lead chloride battery is the most commonly used seawater battery in the sonobuoy program and contains between 300 and 400 g (0.7 and 0.9 lbs) of lead. The amount of lead released into the surrounding area was based on a known battery life of 8 hours and a maximum amount of lead in the seawater cell of 400 g (0.9 lbs). Metallic lead (Pb⁰) is converted to lead ion (Pb⁺²) to obtain a lead concentration in water. Based on the known solubility of lead, a maximum concentration of 11 μg/L (ppb) was calculated within the 1 m cube modeled. This concentration is below the federal acute concentration of 210 μg/L and currents would rapidly dilute the concentration below the daily maximum concentration limit of 8.1 μg/L.

The USEPA limits are based on the assumption that neither the acute (1-hour) nor chronic (96-hour) concentrations exceed the limits more than once every three years on the average. Because the probability of multiple sonobuoys landing in the exact same point of the ocean is minuscule, the federal water quality criteria would not be exceeded in any way.

The amount of copper released from a cuprous thiocyanate seawater battery was calculated to be 0.015 μg/L, well below the federal acute (1-hour) maximum concentration of 4.8 μg/L and the chronic (96-hour) maximum of 3.1 μg/L (USEPA, 2006). The maximum concentration for silver chloride batteries was 0.0001 μg/L, several orders of magnitudes below the daily limit of 2.8 μg/L (USEPA, 1986).

Based on the calculations performed for the three types of batteries, no substantial degradation of marine water quality would occur from the release of metals from batteries (DoN, 1993, 1994a). Other metal and non-metal components that could potentially affect marine water quality include the metal housing (nickel-plated steel coated with polyvinyl chloride [PVC] plastic to reduce corrosion), lithium batteries, and internal wiring, etc., that over time could potentially release chemical constituents into the surrounding water (DoN, 1993).

Seawater corrodes the solid metal components of the sonobuoy slowly, which translates into slow release rates. Once the metal surfaces corrode completely, the rate of metal released into the environment would decrease. Releases of chemical constituents from all metal and non-metal sonobuoy components would be further reduced as a result of natural encrustation of exposed surfaces. Consequently, corrosive components of the sonobuoy would not result in significant degradation of marine water quality (DoN, 1993).
Lithium batteries, used only in active sonobuoys, consist of an exterior nickel-plated steel jacket containing sulfur dioxide (SO₂), lithium metal, carbon, acetonitrile, and lithium bromide (LiBr). During battery operation, the lithium reacts with the sulfur dioxide and forms lithium dioxide (LiO₂). Since the reaction proceeds nearly to completion once the cell is activated, only a limited amount of reactants is present when the battery life terminates. The outer steel jacket develops a protective film from initial corrosion products that greatly reduces further uniform corrosion and the uniform corrosion rate of stainless steel in seawater is apparently too low to measure (Environmental Sciences Group, 2005). Pitting corrosion is unlikely because the temperatures at the bottom of the proposed location are too low to support the process and crevice corrosion is unlikely because a rubber sheath is glued to the outer shell. In addition, natural seawater processes would encrust the outside metal case, which would slow the rate of further corrosion. For these reasons, the lithium battery would not result in significant degradation of marine water quality (DoN, 1993).

About 20 g (0.7 oz) of lead solder are used in the internal wiring of each sonobuoy, and 425 g (15 oz) of lead are used for the transducer node and lead shot ballast. Since these lead sources are in the unionized metallic form of lead that is insoluble in water, the lead shot and solder would not be released into the surrounding seawater. Various lead salts, such as lead chloride (PbCl₂), lead carbonate (PbCO₃), and lead dioxide (PbO₂), would probably form on the exposed metal surfaces; however, these metal salts have limited solubilities of 9.9, 0.001, and 0.14 μg/L, respectively (DoN, 1993). Therefore, lead components of the sonobuoy would not result in significant degradation of marine water quality.

**Countermeasures and Targets**

Lithium sulfur dioxide (LiSO₂) battery cells power both the ADCs and EMATTs. These devices are expendable and sink to the seabed at the end of their battery life. The following points address the chemical reactions that would occur from the presence of these objects in the sea, and demonstrate the absence of impact in all cases.

- Lithium bromide is an extremely soluble salt that dissociates into bromine and lithium ions in seawater. Bromine and lithium are the seventh and fifteenth most-abundant elements present in seawater, respectively. In addition to occurring naturally in seawater, currents would diffuse the concentration of these elements around the ADC or EMATT, thus minimizing any potential impact.

- The lithium metal contained in the ADC or EMATT is extremely reactive with water. When the lithium reacts with water it causes an exothermic (heat liberating) reaction that generates soluble hydrogen gas and lithium hydroxide. The hydrogen gas eventually enters the atmosphere and the lithium hydroxide dissociates, forming lithium ions and hydroxide ions. The hydroxide is neutralized by the hydronium formed from hydrolysis of the acidic sulfur dioxide, ultimately forming water.
Sulfur dioxide, a gas that is highly soluble in water, is the major reactive component in the battery. The sulfur dioxide ionizes in the water, forming bisulfite ($\text{HSO}_3^-$) that is easily oxidized to sulfate in the slightly alkaline environment of the ocean. Sulfur is present as sulfate in large quantities (i.e., 885 milligrams per liter [mg/L]) in the ocean and would disperse rapidly into the surrounding seawater.

Chemical reactions of the lithium sulfur dioxide batteries would be highly localized and short-lived. Ocean currents would greatly diffuse concentrations of the chemicals leached by the ADC or EMATT batteries within a short time period. An evaluation of lithium sulfide dioxide batteries in the marine environment (Environmental Sciences Group, 2005) concluded that: “The standard lithium-sulfur dioxide battery theoretically presents little or no acute or chronic danger to the marine environment. The battery consists of seven material components, and each has been considered in terms of environmental exposure. In each case it was determined that immersion in seawater would result in the formation of either water-soluble or chemically inert waste products. These will be infinitely dispersible and virtually unsusceptible to significant accumulation.” For these reasons and the reactions outlined above, the lithium sulfur dioxide batteries would not significantly affect water quality.

The characteristics of the lead components used in soldering the internal wiring and trim weights from the corrosive components of the ADCs and EMATTs are the same as those associated with the sonobuoys (i.e., limited solubilities and slow release rates); therefore, these lead components would not significantly impact water quality.

### 4.1.2.4 Discharges from Ships

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) prohibits certain discharges of oil, garbage, and other substances from vessels. The MARPOL Convention and its Annexes are implemented by national legislation, including the Act to Prevent Pollution from Ships (APPS) (33 USC 1901 to 1915) and the Federal Water Pollution Control Act (FWPCA) (33 USC 1321 to 1322). These statutes are further implemented and amplified by DoN and the Office of the Chief of Naval Operations Environmental and Natural Resources Program Manual (OPNAVINST 5090.1 series), which establishes U.S. Navy policy, guidance, and requirements for the operation of U.S. Navy vessels. The vessels operating on the USWTR would operate in compliance with the discharge requirements established in OPNAVINST 5090.1 (series).
4.2 Ecological Impacts

The potential non-acoustic impacts on marine organisms at the proposed USWTR Sites A, B, C, and D are discussed together, since impacts are anticipated to be similar at the four sites. Differences that may exist among sites are discussed in each subchapter. Acoustical effects on marine organisms are addressed in Subchapter 4.3.

4.2.1 Plankton and Benthos

4.2.1.1 Range Instrumentation

Installation of the USWTR would entail the placement of approximately 300 transducer nodes in water depths ranging from 37 to 402 m (120 to 1,319 ft), over an approximately 1,713-km² (500-NM²) area. The total seafloor area covered by these components would be approximately 3,300 m² (31,700 ft²).

The interconnect cable between each node was assumed to be completely buried to represent a worst-case scenario. The trunk cable connecting the range to the shore facilities was also assumed to be buried (including within U.S. territory) to a depth of approximately 0.3 to 0.9 m (1 to 3 ft). Ocean-bottom burial equipment would be used to cut (hard bottom) or plow (soft sediment) a furrow approximately 10-cm (4-in) wide, in which the 5.8-cm (2.3-in) diameter cable would be placed. The path of the burial equipment would have an impact on the surficial sediments. This path is expected to be about 5-m (16-ft) wide, resulting in an approximately 920,000 m² (9,903,000 ft²) area of impact and the internode cables would result in an additional 5,550,000 m² (59,739,700 ft²) area of impact. Installation of the trunk cable would avoid impacts on the dredged material ocean disposal sites that exist about 13 km (8 mi) off the beach from the CTF at Charleston and Jacksonville.

This installation process is not expected to have an impact on pelagic plankton. A localized increase in turbidity within the water column is anticipated near the seafloor during construction of the range. Deepwater or bottom-layer ocean currents in the vicinity of the range should quickly disperse sediments stirred-up into the water column and return water column turbidity to pre-installation levels shortly after the installation of range instrumentation is complete. The installation may have a temporary impact on benthic organisms during the placement of the transducer nodes and interconnect cable and the burial of the interconnect and trunk cables. The impact on the benthic community would be short-term, as benthic organisms would recolonize benthic substrate rapidly. Other projects have shown increased colonization by epifaunal organisms on exposed cables (Kogan et al., 2003). Off the coast of Maryland, seafloor cables deposited as part of a USACE-permitted artificial reef program typically were heavily colonized by bivalves and other organisms within the first year or two. These cables rapidly contributed to a structurally complex habitat that attracts large numbers of fishes and lobsters that in turn support local commercial and recreational fishing (Ocean City Reef Foundation, 2004). The recolonization process would occur faster in areas of soft-bottom substrate than it would in hard
bottom substrate. Recovery times would be longer for corals found on hard bottom, as these species have low growth rates.

4.2.1.2 Exercise Torpedoes

No ordnance would be detonated during training exercises; therefore, the physical force that marine organisms would be exposed to would be limited to that produced by torpedo launching and movement. No adverse effects are anticipated from torpedo launches and movement. Torpedoes would be retrieved after exercises are completed.

Torpedo control wires and steel-jacketed lead ballast weights would sink to the bottom and any effects associated with the settling would be short-term. The wire is not anticipated to impact plankton or benthic organisms. Lead ballast weights could potentially crush or smother corals or other sessile benthic invertebrates when they settle on the bottom. However, they would not significantly impact the benthic population due to their limited footprint, and the concentration of lead potentially released would not be above acceptable levels. Once on the seafloor, burial by accumulating sediment would further limit the release of lead into the water column and/or surrounding sediments.

4.2.1.3 Sensing Devices, Countermeasures, and Targets

Sensing Devices

Devices expended on the range would be comprised of XBTs, sonobuoys, and sea gliders, all of which are expected to sink to the seafloor. Sea gliders are used and recovered with no residue. It is estimated that 132 XBTs and 3,000 sonobuoys per year would be used during training exercises. Because of the large number of sonobuoys that would be left in place annually in the USWTR, the potential for these devices to impact marine organisms was analyzed.

The potential for the release into the water column of lead, copper, and silver from sonobuoy batteries to adversely affect marine organisms was studied (DoN, 1993). Concentrations of metals releases from batteries were calculated to be 0.011 mg/L, 0.000015 mg/L, and 0.0000001 mg/L for lead, copper, and silver, respectively (DoN, 1993). These concentrations were compared to the USEPA National Recommended Water Quality Criteria (NRWQCs) to evaluate potential effects on aquatic organisms from acute and chronic exposure to battery releases, as presented in Table 4.2-1.
Table 4.2-1

Metal Toxicity

<table>
<thead>
<tr>
<th>Metal</th>
<th>Saltwater CMC (ug/L) ppb</th>
<th>Saltwater CCC (ug/L) ppb</th>
<th>Initial Concentrations within 1 m³ from battery (ug/L) ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>4.8</td>
<td>3.1</td>
<td>0.015</td>
</tr>
<tr>
<td>Lead</td>
<td>210</td>
<td>8.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Silver</td>
<td>1.9</td>
<td>0.001</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Saltwater aquatic organisms and their uses should not be affected unacceptably if the 4-day average concentration does not exceed the criterion continuous concentrations [CCC] more than once every 3 years on the average (chronic exposure); and if the 24-hour average dissolved copper concentration does not exceed the CMC more than once every 3 years on the average (acute exposure).

The criteria maximum concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The criterion continuous concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are two of the six parts of an aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedance, and chronic frequency of allowed exceedance.

The CMC is based on a one-day (24-hour) average concentration that does not exceed the maximum concentration more than once during the three-year averaging period (acute exposure). The CCC is based on a four-day (96-hour) average concentration that does not exceed the maximum concentration more than once every three years on the average (chronic exposure). As these aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the U.S.

Bioaccumulation criteria have not been developed for lead, copper, or silver. Significant bioaccumulation of lead, copper, and silver in aquatic food chains is unlikely at the concentrations predicted to be released (Eisler, 1988, 1998; Connell et al., 1991). During USWTR exercises organisms would be exposed to battery effluents for a maximum time period of eight hours, due to the limited operational life of the battery (DoN, 1993). At the end of the operational life, the chemical constituents of the battery would have been consumed and chemical releases would cease (DoN, 1993). In addition, concentrations are anticipated to be less than those calculated due to greater dilution occurring in the field than was calculated in the model. Releases would elevate the ambient seawater concentrations of lead, copper, and silver above their normal range only within a very small volume of seawater and only for a very short period, substantially limiting the numbers of organisms exposed to elevated concentrations.
Thus, there would be no adverse effects to benthic and planktonic organisms with respect to chemical releases from sensing devices.

**Countermeasures and Targets**

Ionic metals released during EMATT battery operation and EMATT decomposition do not represent a source of substantial environmental degradation (DoN, *undated*). In a worst-case analysis, ionic metal concentrations have been estimated to reach background levels within 2 m (7 ft) of each EMATT. Due to similarity of ADC composition and because ADCs also use lithium sulfur dioxide batteries, similar conclusions apply to ADC operation and expending.

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**4.2.2 Fish**

**4.2.2.1 Range Instrumentation**

During range installation, the placement of transducers and interconnect cables, as well as the burial of the trunk cable may result in the temporary displacement of benthic fish and mobile invertebrates. It is not anticipated that there would be any lethal impact on fish assemblages in any of the four proposed USWTR sites. There may be limited indirect effects due to loss of small areas of hard bottom from range installation, depending on the extent of hard bottom in the installation area.

**4.2.2.2 Exercise Torpedoes**

Live ordnance would not be used during the training exercises to be conducted on the proposed USWTR ranges; therefore, there would be no impact on fish assemblages at any of the four proposed USWTR locations.

**4.2.2.3 Sensing Devices, Countermeasures, and Targets**

No adverse effects on fish are anticipated from the use of sensing devices, countermeasures, and targets on any of the proposed USWTR sites. Ocean currents at the surface and within the water column would rapidly dilute any metal ions or other chemical constituents released by sonobuoys and EMATTs. No substantial indirect effects on fish species due to the bioaccumulation of ionic metals from affected benthic organisms to higher-order species within the food chain are expected to occur, as no significant bioaccumulation of lead has been found to occur in aquatic food chains (Eisler, 1988). Among aquatic biota, lead concentrations were usually found to be highest in algae and benthic organisms and lowest in upper trophic level predators. In addition to the low bioaccumulation rate, currents continuously disperse and dilute chemical constituents so that organisms are only exposed for a short time period; even within this time, fish and other mobile organisms are likely to move, thereby minimizing individual exposure.
4.2.3 Essential Fish Habitat

4.2.3.1 Range Instrumentation

The interconnect cable between each node was assumed to be buried as a worst-case scenario at all sites. A trunk cable connecting the range to the shore facilities would be buried (including within U.S. territory) to a depth of approximately 0.3 to 0.9 m (1 to 3 ft) at all of the proposed sites. There would be two segments to the buried trunk cable. One segment would run from the shore to a junction box 25 km (14 NM) offshore (the cable would be buried and the junction box would not be buried). From this junction box a second buried cable segment would run to another junction box located at the edge of the range. Ocean-bottom burial equipment would be used to cut (hard bottom) or plow (soft sediment) a furrow approximately 10-cm (4-in) wide in which the 5.8-cm (2.3-in) cable would be placed. The path of the remotely operated vehicle is expected to be approximately 5-m (16-ft) wide, resulting in a maximum area of impact of approximately 920,000 m² (9,903,000 ft²) for the buried trunk cable and 5,550,000 m² (59,739,700 ft²) for the interconnect nodes.

Site A

The following text presents an analysis of the potential impacts of installation of the USWTR on each class of designated EFH at Site A identified in Subchapter 3.2.4 (benthic substrate; live/hard bottom; artificial/manmade reefs; pelagic Sargassum; the water column; currents; nearshore habitats, and HAPCs) occurring within the vicinity of the range. Permanent impacts are those that would result from the permanent placement of the transducer nodes and from the permanent burial of the trunk and interconnect cables in a 10-cm (4-in) wide furrow. Impacts would result from the movement of the ocean bottom burial equipment along a 5-m (16-ft) wide path.

- **Benthic substrate (not including live/hard bottom substrate)** – Placement of the 300 transducer nodes and the burying of the interconnect cables in the range may impact benthic substrate EFH within the vicinity of the proposed Site A. Although the transducer nodes would not be buried, the interconnect cables would be buried, and would overturn and disturb benthic substrate EFH and benthos. As a conservative estimate, the maximum area of substrate (not including hard bottom substrate) potentially impacted by the interconnect cable is 5.6 km² (1.6 NM²). Each of the 300 transducer nodes would cover approximately 5 m² (54 ft²) of soft substrate totaling an area of about 1,500 m² (16,200 ft²). The total area of benthic substrate (not including live/hard bottom substrate) in the range is approximately 935 km² (273 NM²) of which only 0.59 percent would be impacted by the transducers and interconnect cables. Additionally, burying of the trunk cable along the corridor could potentially impact a total area of 0.47 km² (0.14 NM²) which represents approximately 0.03% of all benthic soft substrates within the Site A corridor. This represents a very small area of benthic substrate EFH (not including live/hard bottom substrate) within the Site A range and corridor.
but may result in a reduction of the quantity and/or quality of benthic substrate. Therefore, the installation of range instrumentation and cables at the proposed USWTR Site A may adversely affect, but would not substantially affect, benthic substrate EFH (not including live/hard bottom).

- **Live/hard bottom substrate** – As described in Subchapter 3.2 and shown in Figure 3.2-3, based on the areas surveyed to date, there are areas of live/hard bottom habitat in the Jacksonville OPAREA (DoN, 2009g). Efforts would be made not to place transducer nodes on any live/hard bottom substrate. Burying of the interconnect cables (1,110 km [600 NM] in length) in the range would impact live/hard bottom EFH within the vicinity of the proposed Site A by crushing, covering, or cutting through the live/hard bottom substrate. This action would disturb live/hard bottom substrate EFH and benthic EFH species. Cutting of hard bottom substrates would create rubble that would be deposited in the vicinity of the trench. Rubble substrate produced is expected to be unsuitable for coral colonization (Brooke et al., 2006; NMFS, 2007u), but is expected to be colonized by other organisms. The rock ridge system that extends along the shelf break supports species that utilize benthic substrate EFH and would be impacted if the interconnect cables were installed either over or through the ridge. Permanent impacts would occur on live/hard bottom habitat in the immediate vicinity of the 10-cm (4-in) wide furrow that would be trenched to bury the 5.8-cm (2.3-in) cable. The impact area is estimated to be 5.6 km² (1.6 NM²) and would extend to a depth of approximately 0.3 to 0.9 m (1 to 3 ft). The area potentially impacted represents a small amount (about 0.92 percent) of known live/hard bottom substrate EFH within the proposed Site A range, assuming that the range was installed entirely on live/hard bottom substrate. The potential impact area of the trunk cable (0.47 km²) is estimated by a 5-m (16.4-ft) wide path extending from the range to the shore facility (DoN, 2009g). This area represents about 0.23 percent of the known live/hard bottom in the trunk cable corridor, assuming that the range was installed entirely on live/hard bottom substrate. Even though the estimated impact on live/hard bottom substrate is small, the installation of range instrumentation at the proposed Site A may adversely affect live/hard bottom EFH present in the range.

- **Artificial/manmade reefs** – Based on information presented in Subchapter 3.2.4, 106 artificial reefs are present in the Site A trunk cable corridor and no artificial reefs occur in the Site A range. If artificial reefs were to be encountered during installation of the trunk cable, the installation plan would be altered to avoid them. Therefore, the installation of the range and trunk cable for the proposed USWTR Site A would not adversely affect artificial reef EFH.

- **Pelagic Sargassum** – The presence of pelagic *Sargassum* habitat within the Jacksonville OPAREA is transient and is dependent on prevailing surface currents. No effect on pelagic *Sargassum* EFH is anticipated from the installation
of range instrumentation on the seafloor, because Sargassum is found floating at the sea surface and is not associated with the benthic environment. Any disturbance to Sargassum by surface equipment (e.g., ships) required to perform the installation would be temporary and would not differ significantly from other maritime traffic occurring in the region. No adverse impacts on pelagic Sargassum EFH are expected in either the range or the trunk cable corridor from the installation of range instrumentation at the proposed USWTR Site A.

- **Currents** – Installation of range instrumentation should not impact EFH associated with the Gulf Stream, as the scale of the proposed activities is too small to impede or disturb the Gulf Stream current or to reduce its suitability as EFH. The installation of the range and trunk cable for USWTR Site A would not adversely affect water column EFH.

- **Water column** – The equipment used to excavate the furrow for the cable would cause a localized increase in turbidity from displaced sediments entrained into the water column in the immediate vicinity of the burial equipment. In addition, the placement of approximately 300 transducer nodes each covering 5 m² (54 ft²) of soft sediment would likely result in a localized increase in turbidity in the vicinity of the placement sites. However, deepwater or bottom-layer ocean currents in the vicinity of the range should quickly disperse sediments stirred-up into the water column and return water column turbidity to pre-installation levels shortly after the installation of range instrumentation is complete. Therefore, the installation of range and trunk cable for USWTR Site A would not adversely affect water column EFH.

- **Nearshore EFH** – For the purposes of this assessment, nearshore EFH is defined as those waters within 5.5 km (3 NM) of the shoreline (i.e., state waters) and encompasses only the most shoreward section of the trunk cable corridor – an area of approximately 6.9 km² (2.0 NM²). This dynamic environment provides important habitat for the majority of fish and invertebrate species within EFH in the region.

To bury the trunk cable, a 10-cm (4-in) wide trench would be excavated to a depth of about 0.3 to 0.9 m (1 to 3 ft) using equipment that is approximately 5 m (16 ft) in width. Impacts would be reduced to the maximum extent possible by horizontal directional drilling under the ocean bottom. A conduit can be directionally drilled for a distance of about 610 to 1,220 m (2,000 to 4,000 ft), to an exit point accuracy of 100 m x 100 m (328 ft x 328 ft). If EFH is located in the area of the proposed offshore conduit exit point, it may be possible to avoid the habitat by drilling to a point away from the habitat. If the EFH is so extensive that the exit point cannot avoid impacting the habitat, the conduit exit would impact an area of about 0.93m² (10 ft²). The maximum area (longest distance) potentially impacted in the process of burying the trunk cable is estimated as a 5-m (16.4-ft) wide path.
extending along the edge of the corridor and represents only a small area (0.03 km²) of the nearshore EFH within the corridor. This is a conservative estimate of the impact area because the cable is likely to traverse a shorter distance closer to the middle of the nearshore corridor, which would reduce the total area impacted by the burial process. Impacts EFH in the nearshore corridor associated with burying the trunk cable should be minimal and temporary.

The turbidity of nearshore waters is likely to increase during the cable burying process, which could impact nearshore EFH by reducing light penetration throughout the water column and increasing sedimentation in areas that typically experience low sediment deposition. These impacts would only be temporary as substrate material stirred up into the water column would be quickly dispersed by nearshore currents and tidal fluctuations. Because of the transient nature of the potential impacts resulting from the burial of the trunk cable, the installation of the trunk cable along the corridor may adversely affect, but would not substantially affect, nearshore EFH.

- **HAPC** – HAPC within the proposed USWTR at Site A and the adjacent trunk cable corridor consist primarily of live/hard bottom communities that serve as important spawning areas for members of the snapper-grouper complex and pelagic *Sargassum*. The first habitat type is benthic HAPC and the second is limited to surface waters. The SAFMC did not specifically designate the North Florida MPA as a HAPC. However, areas within the MPAs that meet the criteria for HAPC for species in the snapper-grouper MU are HAPC. Areas in the North Florida MPA that meet the criteria include medium- to high-profile offshore hard bottoms where spawning normally occurs and localities of known or likely periodic spawning aggregations (SAFMC, 1998a). The potential impacts on each of these habitats have been assessed in the sections above.

The SAFMC has recently designated the North Florida MPA which lies within Site A (NMFS, 2009a) (see Figure 3.2-1). The Navy has initiated consultation with the NMFS regarding actions that could be taken to avoid or minimize potential impacts of the construction or operation of the USWTR on the MPA, as well as other EFH.

**Site B**

The following is an analysis of the potential impacts of the installation of the USWTR on each class of designated EFH at Site B identified in Subchapter 3.2.4.2 (benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, currents, nearshore habitats, and HAPCs) occurring within the vicinity of the range. Permanent impacts are those that would result from the permanent placement of the transducer nodes and from the permanent burial of the trunk and interconnect cables in a 10-cm (4-in) wide furrow. Impacts would result from the movement of the ocean bottom burial equipment along a 5-m (16-ft) wide path.
• **Benthic substrate (not including live/hard bottom substrate)** – Placement of the 300 transducer nodes and the burying of the interconnect cables in the range may impact benthic substrate EFH within the vicinity of the proposed Site B. Although the transducer nodes would not be buried, the interconnect cables would be buried and would overturn and disturb benthic substrate EFH and benthos. As a conservative estimate, the maximum area of substrate (not including live/hard bottom substrate) potentially impacted by the interconnect cable is 5.6 km² (1.6 NM²). Each of the 300 transducer nodes would cover approximately 5 m² (54 ft²) of soft substrate totaling an area of about 1,500 m² (16,200 ft²). The total area of benthic substrate (not including live/hard bottom substrate) in the range is approximately 1,285 km² (375 NM²) of which only 0.43 percent would be impacted by the transducers and interconnect cables. Additionally, burying of the trunk cable along the corridor could potentially impact a total area of 0.47 km² (0.14 NM²) which represents approximately 0.0004% of all benthic soft substrates within the Site A corridor. This represents a very small area of benthic substrate EFH (not including live/hard bottom substrate) within the Site B range and corridor, but may result in a reduction of the quantity and/or quality of benthic substrate. Therefore, this action may adversely affect, but would not substantially affect, benthic substrate EFH.

• **Live/hard bottom substrate** – As described in Subchapter 3.2 and shown in Figure 3.2-4, there are areas of live/hard bottom habitat in the Charleston OPAREA, (DoN, 2009g). About 45 percent of the range (668 km² [195 NM²]) has been surveyed for the presence of live/hard bottom. The total area of known live/hard bottom located within the range is 186 km² (54 NM²), which represents 13 percent of the range. In addition, approximately 270 km² (79 NM²) of live/hard bottom has been identified in the corridor, representing 22 percent of the total area of the corridor. Transducer nodes would be placed to avoid live/hard bottom substrate to the maximum extent practical.

Burying of the interconnect cables (1,110 km [600 NM] in length) in the range would impact live/hard bottom EFH within the vicinity of the proposed Site B by crushing, covering, or cutting through the live/hard bottom substrate. This action would disturb live/hard bottom substrate EFH and benthic EFH species. The rock ridge system that extends along the shelf break supports species that utilize benthic substrate EFH and would be impacted if the interconnect cables were installed either over or through the ridge. Permanent impacts would occur on live/hard bottom habitat in the immediate vicinity of the 10-cm (4-in) wide furrow that would be trenched to bury the 5.8-cm (2.3-in) cable. The impact area is estimated to be 5.6 km² (1.6 NM²) and would extend to a depth of 0.3 to 0.9 m (1 to 3 ft). The area potentially impacted, assuming the entire range was installed over live/hard bottom, represents a small amount (about three percent) of known live/hard bottom substrate EFH within the proposed Site B, but would result in a reduction of the quantity and/or quality of hard bottom. In addition, the
installation of the trunk cable corridor may potentially impact up to 0.17% percent of the live/hard bottom in the corridor (assuming the entire cable were laid over live/hard bottom). Therefore, the installation of the range and trunk cable at the proposed Site B may adversely affect live/hard bottom EFH.

Part of the potentially impacted live/hard bottom EFH consists of deepwater coral areas; these are formed primarily by the hermatypic corals, *Lophelia pertusa* and *Enallopsammia profunda*. The deepwater coral areas are located in the southeastern portion of the USWTR Site B, along the shelf break (see Subchapter 3.2.4). The slow growing *L. pertusa* and *E. profunda* are EFH for snapper-grouper species and are within the Charleston Deep Artificial Reef MPA (SAFMC, 2007c). Any damage inflicted on these corals (*Lophelia* and *Enallopsammia*) during the installation of range instrumentation could have a long term and localized significant impact on EFH since these corals would require decades to centuries to recover (Freiwald et al., 2004). Cutting of hard bottom substrates would create rubble that would be deposited in the vicinity of the trench. Rubble substrate produced is expected to be unsuitable for coral colonization (Brooke et al., 2006; NMFS, 2007u), but is expected to be colonized by other organisms. Possible mitigation measures would include benthic surveys of the range in order to acquire more data on the location and size of the *Lophelia* and *Enallopsammia* colonies. Another possible mitigation measure would be to move the range away from the MPA. Should Site B be selected as the Navy’s preferred alternative, the Navy will initiate consultation with the NMFS regarding actions that could be taken to avoid or minimize potential impacts of the construction or operation of the USWTR on the MPA and live/hard bottom EFH.

- **Artificial/manmade reefs** – Based on information presented in Subchapter 3.2.4, there are 12 artificial reefs present in the Site B corridor and no artificial reefs located in the Site B range. If artificial reefs were to be encountered during installation, the installation plan would be altered to avoid them. Therefore, the installation of the range and trunk cable at the proposed USWTR Site B would not adversely affect artificial reef EFH.

- **Pelagic *Sargassum*** – The presence of pelagic *Sargassum* habitat within Site B is transient and is dependent on prevailing surface currents. Installation of the proposed USWTR would not affect any *Sargassum* habitat because *Sargassum* is found floating at the sea surface and is not associated with the benthic environment. Any disturbance to *Sargassum* by surface equipment (e.g., ships) required to perform the installation would be temporary and would not differ significantly from other maritime traffic occurring in the region. Therefore, no adverse impacts on pelagic *Sargassum* EFH are anticipated from the installation of range instrumentation.
- **Currents** – Installation of range instrumentation should not impact EFH associated with the Gulf Stream, as the scale of the proposed activities is too small to impede or disturb the Gulf Stream or to reduce its suitability as EFH. The installation of the range and trunk cable for USWTR Site B would not adversely affect currents EFH.

- **Water column** – Currents in the vicinity of the range should quickly disperse sediments suspended during the installation process and return water column turbidity to pre-installation levels shortly after the installation is completed. Therefore, the installation of the range and trunk cable at the proposed USWTR Site B would not adversely affect water column EFH.

- **Nearshore EFH** – As discussed for Site A, a very small area of nearshore EFH would be impacted by the process of burying the trunk cable in the corridor that connects the USWTR with the shore facility. As described for Site A, impacts would be reduced to the maximum extent possible by horizontal directional drilling under the ocean bottom. The maximum area (longest distance) potentially impacted in the process of burying the trunk cable is estimated as a 5-m (16.4-ft) wide path extending along the edge of the corridor and represents only a small area (0.04 km²) of the nearshore EFH within the corridor. This is a conservative estimate of the impact area because the cable is likely to traverse a shorter distance closer to the middle of the nearshore corridor, which would reduce the total area impacted by the burial process. Impacts on EFH in the nearshore corridor associated with burying the trunk cable should be minimal and temporary (DoN, 2009g).

  The turbidity of nearshore waters is likely to increase during the cable burying process, which could impact nearshore EFH by reducing light penetration throughout the water column and increasing sedimentation in areas that typically experience low sediment deposition. These impacts would only be temporary as substrate material stirred up into the water column would be quickly dispersed by nearshore currents and tidal fluctuations. Because of the transient nature of the potential impacts resulting from the burial of the trunk cable, the installation of the trunk cable along the corridor may adversely affect, but would not substantially affect, nearshore EFH.

- **HAPC** – HAPC within the proposed USWTR at Site B and the adjacent trunk cable corridor consist primarily of live/hard bottom communities that serve as important spawning areas for members of the snapper-grouper complex and pelagic *Sargassum*. The first habitat type is benthic HAPC and the second is limited to surface waters. The potential impacts on each of these habitats have been assessed in the sections above. The SAFMC did not specifically designate the Charleston Deep Artificial Reef MPA as a HAPC. However, areas within the MPAs that meet the criteria for HAPC for species in the snapper-grouper MU are
considered HAPC. Areas in the Charleston Deep Artificial Reef MPA that meet the criteria include medium- to high-profile offshore hard bottoms where spawning normally occurs and localities of known or likely periodic spawning aggregations (SAFMC, 1998a).

The SAFMC has recently designated the Charleston Deep Artificial Reef MPA which lies within Site B (NMFS, 2009a) (See Figure 3.2-2). Should Site B be selected as the Navy’s preferred alternative, the Navy would initiate consultation with the NMFS regarding actions that could be taken to avoid or minimize potential impacts of the construction or operation of the USWTR on the MPA, as well as other EFH.

**Site C**

The marine/offshore EFHs identified as occurring within the vicinity of the range at Site C are benthic substrate, live/hard bottom, artificial/mannmade reefs, pelagic *Sargassum*, currents, water column, nearshore habitats, and HAPC. Permanent impacts are those that would result from the permanent placement of the transducer nodes and from the permanent burial of the trunk and interconnect cables in a 10 cm (4 in) wide furrow. Impacts would result from the movement of the ocean bottom burial equipment along a 5-m (16-ft) wide path.

- **Benthic substrate (not including live/hard bottom substrate)** – Placement of the 300 transducer nodes and the burying of the interconnect cables in the range may impact benthic substrate EFH within the vicinity of the proposed USWTR at Site C. Although the transducer nodes would not be buried, the interconnect cables would be buried, and would overturn and disturb benthic substrate EFH and benthos. As a conservative estimate, the maximum area of substrate (not including live/hard bottom substrate) potentially impacted by the interconnect cable is 5.6 km$^2$ (1.6 NM$^2$). Each of the 300 transducer nodes would cover approximately 5 m$^2$ (54 ft$^2$) of soft substrate totaling an area of about 1,500 m$^2$ (16,200 ft$^2$). The total area of benthic substrate (not including live/hard bottom substrate) in the range is approximately 1,534 km$^2$ (447 NM$^2$), of which only 0.37 percent would be impacted by the transducers and interconnect cables. Additionally, burying of the trunk cable along the corridor could potentially impact a total area of 0.47 km$^2$ (0.14 NM$^2$) which represents approximately 0.03% of all benthic soft substrates within the Site A corridor. This represents a very small area of benthic substrate EFH (not including live/hard bottom substrate) within the range and corridor at Site C, but may result in a reduction of the quantity and/or quality of benthic substrate. Therefore, the installation of the range and trunk cable for USWTR Site C may adversely affect, but would not substantially affect, benthic substrate EFH.

- **Live/hard bottom substrate** – The general location of the live/hard bottom habitat in the vicinity of the proposed Site C USWTR is shown in Figure 3.2-5. About 55 percent of the range (905 km$^2$ [264 NM$^2$]) and 56 percent of the
The corridor (1,021 km² [298 NM²]) has been surveyed for the presence of live/hard bottom. The total estimated area of live/hard bottom in the range, based on survey efforts, is 105 km² (31 NM²) and in the trunk cable corridor is 204 km² (59 NM²).

Burial of the interconnect and trunk cables may impact live/hard bottom within the proposed USWTR location. Transducer nodes would be placed to avoid live/hard bottom substrate to the maximum extent practical. The unburied transducer nodes may serve as alternative hard bottom substrate for colonizing invertebrate organisms, thus potentially offsetting any loss of naturally occurring live/hard bottom habitat caused by the installation process.

Permanent impacts would occur to live/hard bottom habitat in the immediate furrow that is trenched to bury the interconnect cables. As a conservative estimate, the total area of potential live/hard bottom that would be impacted is 5.6 km² (1.6 NM²), assuming the entire series of interconnect cables were laid in areas of live/hard bottom, which is approximately 5.3 percent of the total known live/hard bottom substrate in the range (DoN, 2009g).

Additionally, as a conservative estimate, 0.44 km² (0.13 NM²) of live/hard bottom could be impacted by the burial of the trunk cable, which represents about 0.21 percent of the known live/hard bottom substrate in the corridor. This estimate assumes that the entire area impacted by the installation of the trunk cable consists of live/hard bottom. The area potentially impacted represents a small amount of known live/hard bottom substrate EFH within the proposed Site C, but it would nevertheless result in a reduction of the quantity and/or quality of hard bottom. Therefore, the installation of the range and trunk cable at the proposed USWTR Site C may adversely affect live/hard bottom EFH.

Included within the impacted live/hard bottom EFH are deepwater coral reefs composed primarily of the hermatypic coral, *Lophelia pertusa* also known as the *Lophelia* Reefs, located in the northern and southern part of the USWTR at Site C along the shelf break (see Subchapter 3.2.4). These slow growing coral reefs are EFH for snapper-grouper species, and are on a proposed list as future HAPC sites (SAFMC, 2007b). Any damage inflicted on these corals (*Lophelia*) during the installation of range instrumentation could have a long term and localized significant impact on this habitat because the coral would require decades to centuries to recover (Freiwald et al., 2004). A possible mitigation measure would be to conduct benthic surveys of the range in order to acquire more data on the location and size of the *Lophelia* reefs, and possibly to allow for a shift in the location of the range in order to avoid overlapping with the *Lophelia* reefs.

- **Artificial/manmade reefs** – As discussed in Subchapter 3.2.4 there are no known artificial reefs within the confines of the proposed Site C USWTR or the adjacent trunk cable corridor (see Subchapter 3.5, Figure 3.5-1). If such a structure were to
be encountered during installation, the installation plan would be altered to avoid it. Therefore, the installation of the range and trunk cable at the proposed USWTR Site C would not adversely affect artificial reef EFH.

- **Pelagic Sargassum** – The presence of pelagic *Sargassum* habitat within Site C is transient and is dependent on prevailing surface currents. Installation of the proposed USWTR would not affect any *Sargassum* habitat because it is found floating at the sea surface and is not associated with the benthic environment. Any disturbance to *Sargassum* by surface equipment (e.g., ships) required to perform the installation would be temporary and would not differ significantly from other maritime traffic occurring in the region. Therefore, no adverse impacts on pelagic *Sargassum* EFH are anticipated from the installation of range instrumentation.

- **Currents** – Installation of range instrumentation should not impact EFH associated with the Gulf Stream, as the scale of the proposed activities is too small to impede or disturb the Gulf Stream or to reduce its suitability as EFH. The installation of the range and trunk cable for USWTR Site C would not adversely affect currents EFH.

- **Water column** – Currents in the vicinity of the range should quickly disperse sediments suspended during the installation process and return water column turbidity to pre-installation levels shortly after the installation is completed. Therefore, the installation of the range and trunk cable at the proposed USWTR Site C would not adversely affect water column EFH.

- **Nearshore EFH** – As discussed for Site A, a very small area of nearshore EFH would be impacted by the process of burying the trunk cable in the corridor that connects the USWTR with the shore facility. The maximum area potentially impacted in the process of burying the trunk cable is estimated as a 5-m (16.4-ft) wide path extending along the longest edge of the corridor and represents only a small percentage (0.03 km²) of the nearshore EFH within the corridor. Impacts on non-hard bottom substrate EFH in the nearshore corridor associated with burying the trunk cable should be minimal and temporary (DoN, 2009g) and would be reduced to the maximum extent possible by horizontal directional drilling under the ocean bottom.

  The turbidity of nearshore waters is likely to increase during the cable burying process, but these impacts would only be temporary as substrate material stirred up into the water column would be quickly dispersed by nearshore currents and tidal fluctuations. Because of the transient nature of the potential impacts resulting from the burial of the trunk cable, the installation of the trunk cable along the corridor will not adversely affect non-hard bottom nearshore EFH.
The nearshore corridor has an area of 6.9 km² (2.0 NM²) with approximately 2.2 km² (0.6 NM²) of hard bottom substrate. The longest 5-m (16.4-ft) wide pathway traversing the nearshore area has the potential to impact 0.05 percent of the hard bottom in the nearshore region, which represents a minimal impact on nearshore EFH (DoN, 2009g). Nevertheless, hard bottom EFH in the nearshore region could experience a reduction of the quantity and/or quality. Therefore, the installation of the range and trunk cable at the proposed USWTR Site C may adversely affect nearshore hard bottom EFH.

- **HAPC** – HAPC within the proposed USWTR at Site C and the adjacent trunk cable corridor consist primarily of live/hard bottom communities that serve as important spawning areas for members of the snapper-grouper complex and pelagic *Sargassum*. The first habitat type is benthic HAPC and the second is limited to surface waters. The potential impacts on each of these habitats have been assessed in the sections above.

**Site D**

The following analyzes the potential impacts of installation of the USWTR on each class of designated EFH at Site D identified in Subchapter 3.2.4 (benthic substrate [not including live/hard bottom], live/hard bottom substrate, artificial/manmade reefs, pelagic *Sargassum*, the water column, nearshore habitats, and HAPC).

- **Benthic substrate (not including live/hard bottom substrate)** – Placement of the 300 transducer nodes and the burying of the interconnect cables in the range may impact benthic substrate EFH within the vicinity of the proposed Site D. The total area of benthic substrate (not including live/hard bottom substrate) in the proposed Site D is the entire range (approximately 1,591 km² [464 NM²]) of which only a maximum of 0.35 percent would be impacted by the transducer nodes and interconnect cables. This represents a very small area of benthic substrate EFH, but would result in a reduction of the quantity and/or quality of benthic substrate. Therefore, installation of the range and trunk cable at the proposed USWTR Site D may adversely affect, but would not substantially affect, benthic substrate EFH.

- **Live/hard bottom substrate** – Live/hard bottom EFH in the range and corridor exists only in the form of shipwrecks, which are considered by the MAFMC to be EFH. There is one known shipwreck in the Site D range and 22 in the adjacent trunk cable corridor. Details on the extent or locations of natural live/hard bottom are unavailable (Amato, 1994; USGS, 2000; NAVOCEANO, 2006a, 2006b; MAFMC, 1998b; Hoff, 2006). Placement of the 300 transducer nodes and burial of the interconnect cables and the trunk cable would be conducted to avoid shipwrecks to the greatest extend practical. If a shipwreck is encountered during the installation process the installation plan would be altered to avoid the
shipwreck. Therefore, the installation of the range range and trunk cable for the proposed USWTR Site D would not adversely affect live/hard bottom EFH.

- **Artificial/manmade reefs** – The only known artificial reefs located within the proposed USWTR Site D are shipwrecks (see Subchapter 3.5, Figure 3.5-2). If shipwrecks or other types of artificial reefs are encountered during the installation process, the installation plan would be altered to ensure installation activities avoid them. Therefore, the installation of the range and trunk cable at the proposed USWTR Site D would not adversely affect artificial reef EFH.

- **Pelagic Sargassum** – The presence of *Sargassum* habitat within the VACAPES OPAREA is transient and is dependent on prevailing surface currents. No effect on pelagic *Sargassum* EFH is anticipated from the installation process, because *Sargassum* is found floating at the sea surface and is not associated with the benthic environment. Any disturbance to *Sargassum* by surface equipment (e.g., ships) required to perform the installation would be temporary and would not differ significantly from other maritime traffic occurring in the region. Therefore, no adverse impacts on pelagic *Sargassum* EFH are anticipated from the installation of range instrumentation.

- **Currents EFH** – No currents designated as EFH occur in the vicinity of Site D.

- **Water column** – Currents in the vicinity of the range should quickly disperse sediments suspended during the installation process and return water column turbidity to pre-installation levels shortly after the installation is completed. Therefore, the installation of the range and trunk cable at the proposed USWTR Site D would not adversely affect water column EFH.

- **Nearshore EFH** – As discussed for Site A, a very small area of nearshore EFH would be impacted by the process of burying the trunk cable in the corridor that connects the USWTR with the shore facility. The maximum area potentially impacted in the process of burying the trunk cable is estimated as a 5-m (16.4-ft) wide path extending along the edge of the corridor and represents only a small percentage (0.16 percent or 0.08 km² [0.02 NM²]) of the nearshore EFH within the corridor. Impacts on non-hard bottom substrate EFH in the nearshore corridor associated with burying the trunk cable should be minimal and temporary (DoN, 2009g) and would be reduced to the maximum extent possible by horizontal directional drilling under the ocean bottom.

The turbidity of nearshore waters is likely to increase during the cable burying process, but these impacts would only be temporary as substrate material stirred up into the water column would be quickly dispersed by nearshore currents and tidal fluctuations. Because of the transient nature of the potential impacts resulting from the burial of the trunk cable, no significant impact on non-hard bottom
nearshore EFH is anticipated from the installation process. No naturally occurring hard bottom has been documented in the nearshore region (Amato, 1994; USGS, 2000; NAVOCEANO, 2006a, 2006b; MAFMC, 1998b; Hoff, 2006) and none of the known 22 shipwrecks located in the trunk cable corridor occur in the nearshore region. However, if any shipwrecks are encountered during the installation process, they would be avoided to the greatest extend practical. Therefore, the installation of the trunk cable along the corridor may adversely affect, but would not substantially affect, nearshore EFH.

- **HAPC** – No HAPC are designated in the vicinity of the proposed USWTR Site D or the associated trunk cable corridor; therefore, no adverse effects on HAPCs would occur.

### 4.2.3.2 Exercise Torpedoes

Effects to EFH could potentially result from material introduced into the water column and sediments during torpedo exercises and related activities at the USWTR at any of the four proposed locations. No explosive ordnance would be used during the training exercises and no activity would occur in designated marine sanctuaries. Additionally, all known wrecks would be avoided.

Effects to the water column and seafloor habitats could occur due to the release of torpedoes and associated debris (e.g., parachutes, lead ballast, etc.). The torpedoes would be propelled by Otto Fuel II. The combustion byproducts of this fuel include carbon dioxide, carbon monoxide, water, hydrogen gas, nitrogen gas, ammonia, hydrogen cyanide (HCN), and nitrogen oxides. These substances are exhausted into the torpedo wake, which is extremely turbulent and causes rapid mixing and diffusion. All of the byproducts produced during torpedo use, with the exception of hydrogen cyanide, are below the EPA water quality criteria. The concentration of hydrogen cyanide exceeds the 1-hour recommended value; however, hydrogen cyanide is highly soluble in seawater and dilutes below the EPA criterion within 6.3 m (20.7 ft) of the torpedo pathway. Due to the rapid dilution of chemical releases, accumulation of chemicals in sediments is not likely. Torpedo use may adversely affect EFH within the USWTR at any of the four proposed locations.

The release of steel-jacketed lead ballast in the process of surfaced and recovering the torpedoes could impact seafloor sediments and hard bottom substrates. Chendorian et al. (2002) studied corrosion rates in soil and estimated perforation rates of ½-inch casings to range between 320 to 4,200 years. Most ballasts would be buried by sediments or encrusted by organisms by the time lead would become exposed and once exposed, lead concentrations are likely to be below effects levels (see modeling in Subchapter 4.2.1.3). For ballasts (and other materials) released over soft sediments, once the discarded materials are covered by soft sediments anoxic conditions should dominate, and the materials would have no significant impact on benthic EFH. Ballasts released over hard bottom substrate could potentially damage hard bottom upon initial impact, however, given the size of individual ballasts and the depth of the water column within the USWTR, any damage should not be significant. Additionally, ballast residing on hard bottom substrate may
function as hard substrate for colonial benthic organisms. Torpedo exercises conducted at the USWTR at any of the four proposed locations may adversely affect soft sediments or live/hard bottom EFH.

For detailed, site specific impact analysis on EFH from the use of exercise torpedoes refer to the EFH assessment for the USWTR (DoN, 2009g).

### 4.2.3.3 Sensing Devices, Countermeasures, and Targets

Various countermeasures would be deployed such as acoustic device countermeasures that weigh between 3 and 57 kg (7 and 125 lb), with a diameter of 8 to 15 cm (3 to 6 in) and a length of 102 to 280 cm (40 to 110 in). Throughout the year, 3,000 sonobuoys including XBTs would be deployed within the range that weigh 6 to 18 kg (14 to 39 lb) and are 12.5 cm (4.9 in) in diameter and 91 cm (36 in) in length. Sonobuoys contain lead chloride batteries, parachutes for deployment, exterior cases, and sea anchors.

The maximum seafloor area covered by sonobuoys settling on the bottom was estimated by multiplying the typical length of a sonobuoy (91 cm [36 in]) by the diameter (12.5 cm [4.9 in]) to obtain a footprint of 1,135 cm² (176 in²), or 0.11 m² (1.2 ft²). This number, multiplied by 3,000 (the estimated number of sonobuoys used per year) provides an estimated overall sonobuoy coverage of 330 m² (3,552 ft²). The total coverage of any of the proposed USWTR sites by sonobuoys would be 0.00002% of the USWTR seafloor annually. The sonobuoys, as well as other devices left in place in the USWTR, would degrade and corrode over time. However, if the sonobuoys fell on top of Lophelia reefs, or other fragile live bottom habitats, the impact on the live/hardbottom communities as a result of this action could be more adverse.

Sonobuoys use various types of batteries to power different components. Typical batteries employed include seawater, lithium, and thermal batteries. Soluble battery constituents of potential concern that may be released into the water column or sediments include lead, silver, and copper. Several other constituents such as chloride, bromide, and lithium may be released as well. Several investigations into the potential effects of battery constituents on seawater and sediment conditions found acceptable levels of such substances (ESG, 2005; Kszos et al., 2003; USEPA, 2001; Borener and Maughan, 1998; U.S. Coast Guard, 1994; DoN, 1993). Little accumulation occurred in sediments, and mixing and diffusion resulted in low concentrations in the water column. Therefore, the use of sonobuoy batteries would have no adverse effect on EFH at any of the four proposed USWTR locations.

Both ADCs and EMATTs are powered by lithium sulfur dioxide batteries. The final battery byproducts include lithium ions, hydroxide (which combines with hydronium to form water), and sulfate. All of these substances are considered benign in the marine environment. In addition, the chemical reactions of the batteries would be highly localized and short-lived, and ocean currents would diffuse concentrations of the chemicals leached by the batteries. Due to the rapid dilution of chemical releases, accumulation of chemicals in sediments is not likely. Therefore, the use of
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ADCs or EMATTs would have no adverse effect on EFH at any of the four proposed USWTR locations.

Overall, the use of sensing devices, countermeasures, and targets on any of the four proposed USWTR sites may adversely affect live/hard bottom EFH and benthic HAPC present. For detailed, site specific impact analysis on EFH from the use of sensing devices, countermeasures, and targets refer to the EFH assessment for the USWTR (DoN, 2009g).

### 4.2.4 Sea Turtles and Marine Mammals

#### 4.2.4.1 Range Instrumentation

Burial of the trunk cable would disturb the ocean bottom during construction of the USWTR. Ocean-bottom burial equipment would be used to cut (hard bottom) or plow (soft sediment) a furrow approximately 10 cm (4 in) wide in which the 5.8-cm (2.3-in) diameter cable would be placed. As previously stated, the path of the burial equipment would have an approximately 5-m (16-ft) wide area of impact.

Marine mammals are not likely to be impacted from the operation of this equipment, as they do not typically utilize seafloor habitat for extended periods of time and disturbance from the installation diminishes rapidly in the water column above the seafloor. Sperm whales will come into contact with the bottom while feeding. Incidents of sperm whales becoming entangled in buried cables have been recorded (Heezen, 1957), although these occurrences were exceptionally rare and none have been documented in recent years. Since sperm whales are generally found in deep waters over and past the shelf break (CETAP, 1982; Hain et al., 1985; Smith et al., 1996; Waring et al., 2001a; Davis et al., 2002), they are not expected to be in the vicinity of the buried cable in any of the proposed USWTR sites. Therefore, there would be no effect on sperm whales from the installation of range instrumentation.

The construction period for installing cable is of limited duration at each location. Based on the operating speed of the installation ship – 1 to 3.7 km/hr (0.5 to 2 NM/hr) (see Subchapter 2.2.1) – the ship would install 1 km (0.54 NM) of cable in as little as 16 minutes or as much as 60 minutes. Thus, there would be a limited period during which vessels and construction equipment could come into contact with marine mammals. The Navy concludes that the potential for any harm or harassment to marine mammals is extremely low. Activities related to range instrumentation at the proposed Site A USWTR may affect ESA-listed marine mammals. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.

Green, loggerhead, and Kemp’s ridley sea turtles are associated with ocean bottom habitats (Wynne and Schwartz, 1999). These species may brumate (hibernation in reptiles) by digging into the ocean bottom and burying themselves during limited cold periods. Brumation has been documented at shallow depths (8 to 15 m [26 to 49 ft]) of water in the Gulf of California (Felger...
et al. 1976) and in the Port Canaveral Ship Channel in Florida (Carr et al., 1980). Carr et al. (1980) hypothesized that the loggerheads retrieved in trawls in Florida had gone into the channel to take refuge from low water temperatures. Subsequent attempts to locate overwintering turtles in the same location in Florida and along the Georgia and South Carolina coast located no torpid turtles (Ogren and McVea, 1982). Brumation has not been observed in Virginia or North Carolina (Lutz and Musick, 1997; Epperly et al., 1995b).

Loggerhead, Kemp’s ridley, and green turtles are not tolerant of cold water and reports of cold stunning of these species are frequent along the east coast (Meylan and Sandove, 1986; Cotraneco, 2007; Mazzolini, 2008). Temperatures in these areas fall below the lethal lower limit for loggerheads in the winter (Schwartz, 1978). Ogren and McVea suggested that sea turtle brumation may be limited to a very narrow latitudinal zone at about 29°N. Sea turtles generally rely on migration to avoid northern winters (Ultsch, 2006). Though few studies regarding the physiological response of sea turtles to simulated hibernation have been undertaken, results indicate that sea turtles do not exhibit activity that qualifies as hibernation (Moon et al., 1997) and based on dive duration, there is almost no evidence that hibernating sea turtles remain underwater for the duration of the winter nor can survive for months underwater (Hochscheid et al., 2005). Based on observations and temperature requirements, sea turtles are not expected to engage in this activity within the proposed offshore or nearshore areas of the Sites B, C, or D USWTRs. Sea turtles may possibly brumate off the coast of Florida near the proposed Site A USWTR location for short periods during cold winters.

Cable installation could result in the incidental mortality of sea turtles, and destruction or degradation of bottom habitat utilized by sea turtles. Although take level data is not available for cable installation activities, an annual incidental mortality rate of 95 adult and immature sea turtles – loggerheads, leatherbacks, greens, Kemp’s ridleys, and hawksbills – is attributed to USACE dredging operations in the U.S. Atlantic (Braun-McNeill and Witzell, 2001). The construction period for installing cable is of limited duration at each location; thus, there would be a limited period during which sea turtles using seafloor habitat could potentially be disturbed. Due to the narrow width of the ocean-bottom burial equipment, it is estimated that there would be a low probability that installation equipment would come into direct contact with any turtle that may be on or in bottom sediments, or otherwise utilizing bottom habitats. At the approach of installation equipment turtles and other animals are likely to move out of the immediate area; therefore, direct impacts on sea turtles are expected to be low in number. Additionally, because the impacts on the surficial sediments would be temporary, there would not be any permanent loss of the bottom habitat utilized by turtles. Activities related to range instrumentation at the proposed Site A USWTR may affect sea turtles. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.

Sea turtles are able to orient themselves using the magnetic differences equal to about 0.1 percent of the earth’s natural magnetic field (Lohmann et al., 1999, 2001, 2004). The Earth’s natural background magnetic field strength ranges from approximately 30 to 60 microTeslas (µT) with higher background concentrations closer to the north and south magnetic poles and variations based on physical location and geological characteristics. The cables and transducer nodes that
would be installed are similar to standard equipment used by the telecommunications industry that are regularly used for similar purposes (i.e., to route and transmit data across undersea expanses). The fiber optic cables that would be used have much less ferrous material within them than traditional coaxial cable, thereby resulting in a significantly smaller electromagnetic footprint.

The EMF produced by the cable is less than that of the natural background magnetic force of the earth at distances beyond 0.6 cm (0.25 in) from the cable. As electromagnetic energy dissipates exponentially by distance from the energy source, the magnetic field from the cable would be equal to 0.1 percent of the earth’s at a distance of 6 m (20 ft). The cables and nodes would be installed at the bottom of the ocean floor at a minimum depth of 37 m (120 ft), with the exception of the nearshore installation. Given this depth, sea turtles are unlikely to come into extended contact with cables or nodes and it is extremely unlikely that they would be affected by the magnetic field.

All trunk cable would be buried and interconnect cable would be buried where activities interact with the bottom, such as anchoring and extensive use of bottom-dragged fishing gear. The Navy concludes that the placement and burial of cable, and the interconnect cable that would not be buried would have an extremely low potential for entanglement danger causing any harm or harassment to sea turtles or marine mammals. Activities related to range instrumentation at the proposed Site A USWTR may affect ESA-listed sea turtles. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.

In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from range installation activities at any of the proposed USWTR sites. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters from range installation activities at any of the proposed USWTR sites.

**North Carolina Sea Turtle Sanctuary**

As stated in Subchapter 3.2.4.1, the Onslow Beach landfall site for the proposed Site C USWTR is within a sea turtle sanctuary established by the state of North Carolina to protect sea turtles from the effects of the shrimp trawling industry during nesting season. The trunk cable would be buried within the confines of this nearshore sanctuary area, but no additional consultation is required for activities occurring within the sanctuary.

**Designated North Atlantic Right Whale Critical Habitat**

As stated in Subchapter 3.2.6.1, the area from the mid-Georgia coast extending southward along the Florida coast has been designated as critical habitat as it serves as calving grounds for the North Atlantic right whale. A large portion of this habitat lies within the Jacksonville OPAREA. While the proposed Site A USWTR is located well offshore from the designated critical habitat, the trunk cable would be buried within the confines of the critical habitat. The equipment used to
excavate the furrow for the cable would cause a localized increase in turbidity from displaced sediments entrained into the water column in the immediate vicinity of the burial equipment. In addition, the placement of approximately 300 transducer nodes, each covering \(5 \text{ m}^2\) (54 ft\(^2\)) of soft sediment, would likely result in a localized increase in turbidity in the vicinity of the placement sites. However, deepwater or bottom-layer ocean currents in the vicinity of the range should quickly disperse sediments stirred-up into the water column and return water column turbidity to pre-installation levels shortly after the installation of range instrumentation is complete. Installation of the USWTR may affect the critical habitat. However, no permanent alteration or loss of function of the critical habitat is expected. The Navy initiated consultation with the NMFS in accordance with the ESA for concurrence.

### 4.2.4.2 Exercise Torpedoes

#### Potential Strike Impact

There is negligible risk that a marine mammal or sea turtle could be struck by a torpedo during ASW training events on the USWTR sites. This conclusion is based on: (1) a review of ASW torpedo design features, (2) review of a large number of previous U.S. Navy exercise ASW torpedo events, and (3) post-exercise inspection of all ASW exercise torpedoes.

The acoustic homing programs of Navy ASW torpedoes are designed to detect either the mechanical noise signature of the submarine or active sonar returns from its metal hull with large internal air volume interface. The torpedoes are specifically designed to ignore false targets. As a result, their homing logic does not detect or recognize the relatively small air volume associated with the lungs of marine mammals or sea turtles. They do not detect or home to marine mammals or sea turtles.

The Navy has conducted ASW EXTORP events since 1968. At least 14,000 EXTORP runs have been conducted during the time period from 1968 to the present. Although the areas where these EXTORP runs host marine mammal stocks equal to or greater in size than those of the prospective USWTR, there have been no recorded/reported instances of a marine mammal (or sea turtle) strike by an EXTORP. This review of EXTORP events included both interviews with supervisory personnel who have been on scene for torpedo firing events since 1971, and a records review of the more than 5,000 events that have occurred since 1990. These records include data on the actual exercise event and the post-exercise inspection of the EXTORP.

Every EXTORP event is monitored acoustically by on-scene range personnel listening to range hydrophones positioned on the ocean floor in the immediate vicinity of the torpedo event. After each torpedo run, the recovered EXTORP is thoroughly inspected for any damage. The torpedoes then go through an extensive production line refurbishment process for re-use. This production line has stringent quality control procedures to ensure that the torpedo will safely and effectively operate during its next run. Since these EXTORPs are frequently used against manned Navy submarines, this post-event inspection process is thorough and accurate. Inspection records and quality control documents prepared for each exercise torpedo run show
no evidence of marine mammal or sea turtle strikes. Such evidence could include loss of the exercise torpedo, damage to the nose cone, or debris attached to the exercise torpedo. This post-exercise inspection is the basis that supports the conclusion of negligible risk of marine mammal strike. Therefore, the use of torpedoes during ASW training operations on the range would not affect listed marine mammal species or take species protected under the MMPA. The probability of direct strike of torpedoes at the proposed USWTR sites is negligible and therefore would have no effect on ESA-listed marine mammal species. Torpedo activities at the proposed USWTR sites would not result in harassment of any marine mammal species.

In accordance with NEPA, there would be no significant impact to marine mammals in territorial waters resulting from interactions with torpedoes on any of the proposed USWTR sites. In accordance with EO 12114, there would be no significant harm to marine mammals in non-territorial waters resulting from interactions with torpedoes on any of the proposed USWTR sites.

With respect to sea turtles, given their relatively small size, there is negligible risk that a turtle could be struck by a torpedo during ASW training events on the USWTR sites given the total area of sea turtles present relative to the total USWTR area. The Navy believes the potential for any harm or harassment to sea turtles is extremely low. The post-exercise inspection is also the basis that supports the conclusion of negligible risk of sea turtle strike. Therefore, the use of torpedoes during ASW training operations on the range would not affect ESA-listed sea turtles. In accordance with NEPA, there would be no significant impact to sea turtles in territorial waters resulting from interactions with torpedoes on any of the proposed USWTR sites. In accordance with EO 12114, there would be no significant harm to sea turtles in non-territorial waters resulting from interactions with torpedoes on any of the proposed USWTR sites.

**Control Wires**

As discussed in Subchapter 4.1, the Mk 48 EXTORP is equipped with a single-strand control wire, which is laid behind the torpedo as it moves through the water. At the end of a torpedo run, the control wire is released from the firing vessel and the torpedo to enable torpedo recovery. The wire sinks rapidly and settles on the ocean floor. Guidance wires are expended with each Mk 48 EXTORP launched. Each year, about 48 Mk 48 EXTORPs would be used on the USWTR and, therefore, the same number of control wires would be expended annually.

DoN (1996b) analyzed the potential entanglement impact of Mk 48 torpedo control wires on sea turtles and marine mammals. The DoN analysis concluded that the potential for entanglement impact would be low for the following reasons:

- The control wire has a relatively low breaking strength (19 kg [42 lb]). With the exception of a chance encounter with the control wire while it was sinking to the seafloor (at an estimated rate of 0.2 m [0.5 ft] per second), a marine mammal or sea turtle would be vulnerable to entanglement only if its diving and feeding patterns place it in contact with the bottom.
The torpedo control wire is held stationary in the water column by drag forces as it is pulled from the torpedo in a relatively straight line until its length becomes sufficient for it to form a catenary droop (DoN, 1996b). When the wire is cut or broken, it is relatively straight and the physical characteristics of the wire prevent it from tangling, unlike the monofilament fishing lines and polypropylene ropes identified in the entanglement literature (DoN, 1996b).

Given the low potential probability of sea turtle and marine mammal entanglement with control wires, the Navy believes the potential for any harm or harassment to these species is extremely low. The torpedo control wires associated with activities at any of the proposed USWTR sites may affect ESA-listed marine mammal and sea turtle species. Control wires would not result in the harassment of any marine mammal species.

In accordance with NEPA, there would be no significant impact to marine mammals and sea turtles in territorial waters from control wires associated with torpedo activities at any of the proposed USWTR sites. In accordance with EO 12114, there would be no significant harm to marine mammals and sea turtles in non-territorial waters from control wires associated with torpedo activities at any of the proposed USWTR sites.

**Air Launch Accessories**

Because the Mk 46 and Mk 54 torpedo air launch accessories remain in the marine environment, the potential for impacting sea turtles and marine mammals through ingestion or entanglement was analyzed. Ingestion of pieces of the launch accessories is unlikely because most are large and metallic and would sink rapidly (DoN, 1996a). With the exception of a chance encounter as the air launch accessories sink to the bottom, marine animals would only be vulnerable to entanglement or ingestion impacts if their diving and feeding behaviors place them in contact with the seafloor.

The Naval Ocean Systems Center (NOSC, 1990) identified two potential impacts of the Mk 54 air launch accessories. As the air launch accessories for the Mk 46 torpedo are similar in function, materials, and size to those of the Mk 54 torpedo, the following potential impacts identified by NOSC are applicable to both torpedoes (DoN, 1996a):

- Upon water entry and engine startup, the air stabilizer would be released from the torpedo and sink to the bottom. Bottom currents may cause the air stabilizer canopy to billow, potentially posing an entanglement threat to marine animals that feed on the bottom. However, the canopy is highly visible compared to materials such as gill nets and nylon fishing line in which marine animals may become entangled. Thus, entanglement of marine animals in the canopy or suspension lines would be unlikely. The canopies range in diameter from 0.37 to 0.84 m² (4 to 9 ft²). Subchapter 4.2.4.5 provides a more detailed assessment of the potential risk of marine mammals or sea turtles becoming entangled in or ingesting Mk 46...
and Mk 54 air stabilizer canopies, as well as the parachutes from aircraft-launched EMATTs and sonobuoys, and ship-launched VLAs.

- Non-floating air launch debris ranges in length from 28 to 112 cm (11 to 44 in). Due the limited amount of debris, its relatively large size, and because benthic feeding whales only incidentally ingest debris, the potential risk for ingestion of this debris by marine animals other than bottom-feeding whales would be small. The probability of a bottom-feeding whale coming in contact with and ingesting the debris likewise would be small.

Air launch accessories (particularly the canopy) associated with torpedo activities on the proposed USWTR may affect ESA-listed species of marine mammals and sea turtles. These accessories would not result in the harassment of any species of marine mammals.

In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from air launch accessories associated with torpedo activities on the proposed USWTR. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters from air launch accessories associated with torpedo activities on the proposed USWTR.

**Flex Hoses**

As discussed in Subchapter 4.1.2.2, the Mk 48 torpedo uses either an SFH or IFH. The IFH is a multi-component design that consists of a stainless-steel spring overlaid with a polyester braid and then a layer of lead tape (DoN, 1996b). The entire assembly is then overlaid with a stainless-steel wire braid (DoN, 1996b). The SFH is constructed primarily of stainless steel (DoN, 1996b).

Approximately 48 Mk 48 torpedoes would be used annually on the proposed USWTR; therefore, 48 flex hoses (SFHs or IFHs) would be expended. DoN (1996b) analyzed the potential for the flex hoses to impact sea turtles and marine mammals. The analysis concluded that the potential entanglement impact on marine animals would be insignificant for reasons similar to those stated for the potential entanglement impact of control wires, specifically:

- Due to its weight, the flex hose would rapidly sink to the bottom upon release, at a rate of approximately 15 cm (6 in) per second. With the exception of a chance encounter with the flex hose while it was sinking to the seafloor, a marine animal would be vulnerable to entanglement only if its diving and feeding patterns placed it in contact with the bottom.

- Due to its stiffness, the 76.2-m (250-ft) long flex hose, with a diameter of 1.3 cm (0.5 in), would not form loops that could entangle marine animals. The flex hose is designed specifically to avoid entanglement with itself during deployment.
Flex hoses associated with torpedo activities on the proposed USWTR sites may affect ESA-listed species of marine mammals or sea turtles. These activities would not result in the harassment of any species of marine mammals.

In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from flex hoses associated with activities on the proposed USWTR. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters from flex hoses associated with activities on the proposed USWTR.

**Sodium Fluorescein Dye**

The exercise head section of the Mk 46 and Mk 48 torpedoes is fitted with a dye container, which is filled with an estimated 109 g (3.7 oz) of sodium fluorescein dye (DoN, 1996a, 1996b), which is commonly used as a tracer dye in groundwater and surface water studies and extensively as a diagnostic tool in ophthalmology (e.g., Freeman et al., 1998). Any concentrations encountered by listed species in the area would be far below the established lethal doses for smaller mammals. In addition, studies have found no evidence of carcinogenesis or other negative effects for long-term exposure (O’goshi and Serup, 2006). At the end of the torpedo run, the dye discharges into the seawater to enhance visibility and facilitate the recovery of the torpedo. Sodium fluorescein dye is easily visible in very dilute solutions. The dye is commonly used to trace the flow of water and poses no harm to aquatic life at the concentrations that would occur during Mk 46 and Mk 48 torpedoes recovery operations.

As sodium fluorescein dye disperses rapidly – typically in less than one hour, with sea state significantly impacting the dispersion – the Navy believes the potential for any harm or harassment to sea turtles or marine mammals is extremely low. Sodium fluorescein dye associated with the Mk 46 and Mk 48 torpedoes that would be used on the proposed USWTR would have no effect on ESA-listed marine mammals or sea turtles. The use of this dye would not result in the harassment of any species of marine mammals.

In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from the use of sodium fluorescein dye on the proposed USWTR. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters from the use of sodium fluorescein dye on the proposed USWTR.

**4.2.4.3 Sensing Devices, Countermeasures, and Targets**

**Sensing Devices and Countermeasures**

As previously discussed in Subchapters 4.2.1.3, 4.2.2.3, and 4.2.3.3, no adverse effects from sonobuoy or countermeasure effluents are anticipated.
Targets

The potential for direct physical contact between an EMATT, which is 12.4 by 91.4 cm (4.9 by 36.0 in), and a sea turtle or marine mammal is extremely low given the generally low probability of occurrence of these animals at the immediate location of deployment, the size of individual animals and the density of sea turtles and marine mammals in relation to the area of the USWTR, and the reconnaissance procedures implemented prior to and during exercises (see Subchapters 6.1.2.3 Operating Procedures and 6.1.3 Conservation Measures). Therefore, the deployment of EMATTs on the range would have no effect on ESA-listed species of sea turtles or marine mammals. The deployment of EMATTs on the proposed USWTR would not result in the harassment of any species of marine mammals.

In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from target deployment or use on the proposed USWTR. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters from target deployment or use on the proposed USWTR.

4.2.4.4 Navy Vessels

Collisions with commercial and Navy ships, and recreational boats can result in serious injury and may occasionally cause fatalities to sea turtles, cetaceans, and manatees. Although the most vulnerable marine mammals may be assumed to be slow-moving cetaceans or those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., sperm whales), fin whales are actually struck most frequently (Laist et al., 2001). Manatees are also particularly susceptible to vessel interactions and collisions with watercraft constitute the leading cause of mortality (USFWS, 2001b). Smaller marine mammals such as bottlenose and Atlantic spotted dolphins move more quickly throughout the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC, 2003).

After reviewing historical records and computerized stranding databases for evidence of ship strikes involving baleen and sperm whales, Laist et al. (2001) found that accounts of large whale ship strikes involving motorized boats in the area date back to at least the late 1800s. Ship collisions remained infrequent until the 1950s, after which they increased. Laist et al. (2001) report that both the number and speed of motorized vessels have increased over time for trans-Atlantic passenger services, which transit through the area. They concluded that most strikes occur over or near the continental shelf, that ship strikes likely have a negligible effect on the status of most whale populations, but that for small populations or segments of populations the impact of ship strikes may be significant. Although ship strike mortalities may represent a small proportion of whale populations, Laist et al. (2001) also concluded that, when considered in combination with other human-related mortalities in the area (e.g., entanglement in fishing gear), these ship strikes may present a concern for whale populations.
Of 11 species known to be hit by ships, fin whales are struck most frequently; right whales, humpback whales, sperm whales, and gray whales are all hit commonly (Laist et al., 2001). In some areas, one-third of all fin whale and right whale strandings appear to involve ship strikes. Sperm whales spend long periods (typically up to ten minutes; Jaquet and Whitehead, 1996) "rafting" at the surface between deep dives. This could make them exceptionally vulnerable to ship strikes. Berzin (1972) noted that there were "many" reports of sperm whales of different age classes being struck by vessels, including passenger ships and tug boats. There were also instances in which sperm whales approached vessels too closely and were cut by the propellers (NMFS, 2006e).

Accordingly, the Navy has adopted mitigation measures to reduce the potential for collisions with surfaced marine mammals and sea turtles. These measures include the following:

- Using lookouts trained to detect all objects on the surface of the water, including marine mammals and sea turtles.
- Implementing reasonable and prudent actions to avoid the close interaction of Navy assets and marine mammals and sea turtles.
- Maneuvering to keep away from any observed marine mammal.

Navy shipboard lookouts are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the Officer of the Deck (e.g., trash, a periscope, marine mammals, sea turtles) and all disturbances (e.g., surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a ship or surfaced submarine is moving through the water. Navy lookouts undergo extensive training in order to qualify as a lookout. This training includes on-the-job instruction under the supervision of an experienced lookout, followed by completion of the Personal Qualification Standard program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).

The Navy includes marine species awareness as part of its training for its bridge lookout personnel on ships and submarines. Lookouts are trained how to look for marine species, and report sightings to the Officer of the Deck so that action may be taken to avoid the marine species or adjust the exercise to minimize effects to the species. Marine Species Awareness Training was updated in 2006, and the additional training materials are now included as required training for Navy ship and submarine lookouts. Additionally, all commanding officers and executive officers of units involved in training exercises are required to undergo marine species awareness training. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments, and general observation information to aid in avoiding interactions with marine species.
North Atlantic right whales are of particular concern. On average one or two right whales are killed annually in collisions. Between 2001 and 2007, at least eight right whales, including four adult females, a juvenile male, a juvenile female, and a female calf died as a result of being struck by ships (MMC, 2008; Nelson et al., 2007).

In order to reduce the risk of ship strikes, the Navy has instituted North Atlantic right whale protective measures that cover vessels operating all along the Atlantic coast. Standing protective measures and annual guidance have been in place for ships in the vicinity of the right whale critical habitat off the Southeast coast since 1997. In addition to specific operating guidelines, the Navy’s efforts in the southeast include annual funding support to the Early Warning System, and organization of a communication network and reporting system to ensure the widest possible dissemination of right whale sighting information to DoD and civilian shipping. The Early Warning System includes aerial surveillance flights (currently 1 December - 31 March) in east-west transects from the shoreline to approximately 56-65 km (30-35 NM) offshore and are flown at an altitude of 305 m (1,000 ft) above sea level. Right whale sighting information is transmitted from the aircraft team to a ground contact who immediately forwards information, via e-mail, to FACSFAC JAX, USACE, USCG, JAXPORT and a large network made up of local, state, federal, non-profit and commercial interests, who are on the distribution list. As a network member, the USCG transmits a Broadcast Notice to Mariners over VHF marine-band radio channel 16. The Navy only notifies Navy vessels within the JAX OPAREA area of whale sightings. The USCG notifies commercial interests of sights.

In 2002, right whale protective measures were promulgated for all Fleet activities occurring in the Northeast region and most recently, in December 2004, the U.S. Navy issued further guidance for all Fleet ships to increase awareness of right whale migratory patterns and implement additional protective measures along the mid-Atlantic coast. This includes areas where ships transit between southern New England and northern Florida. The Navy coordinated with the NMFS for identification of seasonal right whale occurrence patterns in six major sections of the mid-Atlantic coast, with particular attention to port and coastal areas of key interest for vessel traffic management. The Navy’s resulting guidance calls for extreme caution and operation at a slow, safe speed within 37-km (20-NM) arcs of specified coastal and port reference points. The guidance reiterates previous instructions that Navy ships post two lookouts, one of whom must have completed marine mammal recognition training, and emphasizes the need for utmost vigilance in performance of these lookout duties.

Right whale protective measures as they apply to the four USWTR alternative sites are tailored according to the temporal and spatial distribution of right whales expected at each location. For Site A, the Southeast Protective measures covering the right whale consultation area and Southeast Critical Habitat apply. These include:

- Annual message sent to all ships prior to the November 15 through April 15 calving season.
Movement through the critical habitat will be in the most direct manner possible, avoiding north-south transits during the calving season.

Vessels will use extreme caution and operate at a slow, safe speed; that is the slowest speed consistent with essential mission, training, and operations at which the ship can take proper and effective action to avoid a collision and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

To the extent practicable and consistent with mission, training and operations, naval vessel operations in the critical habitat and associated area of concern will be limited to daylight and periods of good visibility.

Based on these standard operating procedures, collisions with right whales or other cetaceans, or with sea turtles are not expected in the area of Site A. The Navy is committed to using the best available science and will to continue to work with the NMFS regarding North Atlantic right whales as new information becomes available.

The Navy has enacted additional protective measures to protect North Atlantic right whales in the mid-Atlantic region within which the other three alternatives – Sites B, C, and D – are located. As described in Subchapter 3.2, the mid-Atlantic is a principal migratory corridor for North Atlantic right whales that travel between the calving/nursery areas in the Southeastern U.S. and feeding grounds in the northeast U.S. and Canada. Transit to the proposed USWTR sites from mid-Atlantic ports requires Navy vessels to cross the migratory route of North Atlantic right whales. Southward right whale migration generally occurs from mid- to late November, although some right whales may arrive off the Florida coast in early November and stay into late March (Kraus et al., 1993). The northbound migration generally takes place between January and late March. Data indicate that during the spring and fall migration, right whales typically occur in shallow water immediately adjacent to the coast, with over half the sightings (63.8 percent) occurring within 18.5 km (10 NM), and 94.1 percent reported within 55 km (30 NM) of the coast.

Given the low abundance of North Atlantic right whales relative to other species, the frequency of occurrence of ship strikes to right whales suggests that the threat of ship strikes is proportionally greater to this species (Jensen and Silber, 2004). Vessel speed is an important factor affecting the likelihood and lethality of vessel collisions with whales (Laist et al., 2001; Jensen and Silber, 2004; Vanderlaan and Taggart, 2007). Therefore, in 2004, the NMFS proposed a right whale vessel collision reduction strategy to consider the establishment of operational measures for the shipping industry to reduce the potential for large vessel ship strikes of North Atlantic right whales while transiting to and from mid-Atlantic ports during right whale migratory periods (NOAA, 2008d). Recent studies of right whales have shown that these whales tend to lack a response to the sounds of oncoming vessels (Nowacek et al., 2004). Although Navy vessel traffic generally represents only 2-3 percent of the overall large vessel traffic, based on this biological characteristic and the presence of critical Navy ports along the whales’ mid-
Atlantic migratory corridor, the Navy was the first federal agency to adopt additional protective measures for transits in the vicinity of mid-Atlantic ports during right whale migration.

Specific to right whale avoidance, the Navy has unilaterally adopted the following protective measures:

- During months of expected North Atlantic right whale occurrence, Navy vessels will practice increased vigilance with respect to avoidance of vessel-whale interactions along the mid-Atlantic coast, including transits to and from any mid-Atlantic ports.

- All surface units transiting within 56 km (30 NM) of the coast in the mid-Atlantic will ensure at least two watchstanders are posted, including at least one lookout that has completed required marine mammal awareness training.

- Navy vessels will avoid knowingly approaching any whale head on and will maneuver to keep at least 460 m (1,500 ft) away from any observed whale, consistent with vessel safety.

For purposes of these measures, the mid-Atlantic is defined broadly to include ports south and east of Block Island Sound, Rhode Island southward to South Carolina. These measures are similar to vessel transit procedures in place since 1997 for Navy vessels in the vicinity of designated right whale critical habitat in the southeastern U.S. Based on the implementation of Navy mitigation measures, especially during times of anticipated right whale occurrence, and the relatively low density of Navy ships in the USWTR sites, the likelihood that a vessel collision would occur is very low.

There would be no significant impact to sea turtles or marine mammals from vessel interactions during USWTR activities within territorial waters under Alternative A, Alternative B, Alternative C, Alternative D, or the No Action Alternative. In addition, there would be no significant harm to sea turtles or marine mammals resulting from vessel interactions during USWTR activities in non-territorial waters under Alternative A, Alternative B, Alternative C, or Alternative D. USWTR activities with respect to vessel strikes may affect ESA-listed sea turtle or marine mammal species. The Navy is consulting with the NMFS in accordance with the ESA.

### 4.2.4.5 Parachutes

Aircraft-launched EMATTs, lightweight torpedoes, sonobuoys, and ship-launched VLAs (see Table 2-2) deploy nylon parachutes of varying sizes. At water impact, the parachute assembly is jettisoned and sinks away from the exercise weapon or target. The parachute assembly would potentially be at the surface for a short time before sinking to the seafloor.

Many large sea turtles subsist mainly on jellyfish, and the incidence of plastic bags found in dead turtles indicates that the turtles may mistake floating plastic bags for jellyfish (Cottingham,
Sea turtles also ingest pieces of polystyrene foam, monofilament fishing line, and several other kinds of synthetic drift items. Some ingestion of plastics by marine mammals is known to occur (e.g., Tarpley and Marwitz, 1993; Whitaker et al., 1994; Secchi, and Zarzur, 1999; Baird and Hooker, 2000). However, the parachutes used on the proposed USWTR are large in comparison with these animals’ normal food items, and would be very difficult to ingest.

Sea turtles and marine mammals are also subject to entanglement in marine debris, particularly anything incorporating loops or rings, hooks and lines, or sharp objects. Entanglement and the eventual drowning of a sea turtle or marine mammal in a parachute assembly would be unlikely, since the parachute would have to land directly on an animal, or an animal would have to swim into it before it sinks. The potential for a sea turtle or marine mammal to encounter an expended parachute assembly is extremely low, given the generally low probability of a sea turtle or marine mammal being in the immediate location of deployment, especially given the mitigation measures outlined in Chapter 6. If bottom currents are present, the canopy may temporarily billow and pose an entanglement threat to marine animals with bottom-feeding habits; however, the probability of a sea turtle or marine mammal encountering a parachute assembly on the seafloor and the potential for accidental entanglement in the canopy or suspension lines is considered to be unlikely. Once the expended parachute assembly has landed, it and its housing are expected to lay flat on the seafloor, as observed at other locations (ESG, 2005).

The possibility of sea turtles or marine mammals ingesting nylon parachute fabric or being entangled in parachute assemblies is very remote. The use of parachutes on the proposed USWTR may affect ESA-listed species of marine mammals and sea turtles. The use of parachutes on the proposed USWTR may affect marine mammals.

In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from the use of parachutes on the proposed USWTR. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters from the use of parachutes on the proposed USWTR.

4.2.4.6 Effects on Prey Species

Marine animals such as sea turtles and marine mammals subsist on a variety of prey species including plankton, invertebrates, and fish. Information in Subchapter 3.3.1.6 - Summary of Acoustical Screening, Subchapter 4.2.1 - Ecological Impacts to Plankton and Benthos, and Subchapter 4.2.2 - Ecological Impacts to Fish demonstrates that no effects are expected for invertebrates, fish, or plankton, and therefore the prey of marine mammals and sea turtles would not be affected by the proposed action.

4.2.5 Seabirds and Migratory Birds

No significant impacts to seabirds and migratory birds would occur from the operation of the USWTR at any of the proposed sites. Construction activities would primarily be limited to the
ocean bottom and are, therefore, unlikely to impact birds. The proposed USWTR operations would not have a significant impact on birds at sea, which are capable of flying long distances and are likely to move away from temporary disturbances. With respect to migratory birds, all four proposed USWTR sites are located offshore from the principal routes of migratory birds; thus, no impacts are anticipated.

The potential exists for seabirds to become entangled in expended materials, particularly anything incorporating loops or rings, hooks and lines, or sharp objects. Possible expended materials from USWTR activities are nylon parachutes of varying sizes. At water impact, the parachute assembly is expended and it sinks away from the exercise weapon or target. The parachute assembly will potentially be at the surface for a short time before sinking to the sea floor. Entanglement and the actual drowning of a seabird in a parachute assembly is unlikely, since the parachute would have to land directly on the animal, or a diving seabird would have to be diving exactly underneath the location of the sinking parachute. The potential for a seabird to encounter an expended parachute is extremely low, given the generally low probability of a seabird being in the immediate location of deployment.

As stated in Section 3.2.8.3, there are two threatened or endangered birds – the Bermuda petrel and the roseate tern – that may occur in some or all of the range areas. However, the Bermuda petrel will rarely occur along the east coast, preferring to nest on islets off Bermuda. Moreover, the roseate tern prefers beaches and sandbars. As such, there will be no effect on threatened or endangered seabirds from installation of the USWTR or from the operation of the USWTR at any of the four proposed locations.

### 4.2.6 Endangered and Threatened Species

As discussed in Subchapters 4.2.4 and 4.2.5, the non-acoustic activities associated with the proposed action may affect threatened or endangered sea turtles and marine mammals. Proposed USWTR operations may affect ESA-listed sea turtles and marine mammals. The in-water construction from range installation may affect ESA-listed sea turtles and marine mammals at any of the proposed USWTR sites. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.

In the Jacksonville OPAREA, the North Atlantic right whale designated critical habitat extends to 28 km (15 NM) from the coast. The proposed Site A USWTR location is well outside the critical habitat; the proposed range site edge is approximately 93 km (50 NM) from shore. Therefore, proposed USWTR operations would not affect the designated critical habitat.

The Navy is consulting with the NMFS in accordance with the ESA. Potential impacts of range installation on North Atlantic right whale critical habitat are being discussed with the NMFS and the Navy would comply with the ESA with respect to the critical habitat. No critical habitats are designated in Sites B, C, or D.
Potential acoustic effects of proposed USWTR operations on ESA-listed marine mammals are detailed in Subchapter 4.3 and potential landside construction impacts to ESA-listed species are described in Subchapter 4.6.
4.3 Acoustic Effects

The screening process used to define the marine animal species that need to be considered from an acoustical effect perspective was presented in Subchapter 3.3, concluding that plankton, invertebrates, seabirds, sea turtles, and pinnipeds are appropriately excluded from this acoustic effects analysis. This subchapter therefore contains analyses of potential acoustic effects that may occur to cetaceans (dolphins and whales), fish, and human divers. Because all cetaceans are protected under the MMPA and mid-frequency active (MFA) sonars have the potential to adversely affect these species, the bulk of this subchapter (4.3.1 to 4.3.12) is devoted to analyzing the potential effects of underwater sonars on cetaceans. Potential effects to fish are evaluated in Subchapter 4.3.11. Potential effects of active military sonar systems on human divers are discussed in Subchapter 4.3.12. The potential effects of aircraft noise on marine mammals and fish are discussed in Subchapter 4.3.10.

Estimating potential acoustic effects on cetaceans entails answering the following questions:

- **What action will occur?** This requires identification of all acoustic sources that would be used in the exercises and the specific outputs of those sources. This information is provided in Subchapter 4.3.5.

- **Where and when will the action occur?** The place, season, and time of the action are important to:
  - determine which marine mammal species are likely to be present. Species occurrence and density data (Chapter 3) are used to determine the subset of marine mammals for consideration and to estimate the distribution of those species.
  - predict the underwater acoustic environment that would be encountered. The acoustic environment here refers to environmental factors that influence the propagation of underwater sound. Acoustic parameters influenced by the place, season, and time are described in Subchapter 4.3.6.

- **What are the predicted sound exposures for the species present?** This requires appropriate sound propagation models to predict the anticipated sound levels as a function of source location, animal location and depth, and season and time of the action. The sound propagation models and predicted acoustic exposures are described in Subchapter 4.3.7.

- **What are the potential effects of sound on the species present?** This requires an analysis of the manner in which sound interacts with the physiology of marine mammals and the potential responses of those animals to sound. Subchapter 4.3.1
presents the conceptual framework used in this OEIS/EIS to evaluate the potential
effects of sound on marine mammal physiology and behavior. When possible,
specific criteria and numeric values are derived to relate acoustic exposure to the
likelihood of a particular effect.

- **How many marine mammals are predicted to be harmed or harassed?** This
  requires potential effects to be evaluated within the context of the existing
  regulations. Subchapter 4.3.2 reviews the regulatory framework and premises
  upon which the effects analyses in this OEIS/EIS are based. Numeric criteria for
  MMPA harassment are presented in sections 4.3.3. Subchapters 4.3.8 and 4.3.9
  discuss the anticipated acoustic effects to ESA-listed and non-listed marine
  mammals, respectively.

- **What is the potential of effect to the species population?** The number and
  magnitude of harassments must be assessed to determine if there will be an
  impact to reproduction, which could result in an extended effect to the population
  level due to reduced recruitment. This process must be performed for animals
  listed under the ESA. Subchapters 4.3.8 and 4.3.9 discuss population and species
  effects related to ESA-listed marine mammals in the proposed USWTR locations.

The Navy has initiated consultation with NMFS to address potential effects to marine mammals
and sea turtles from sound associated with USWTR activities under the ESA. The Navy will
consult with NMFS to address potential effects to marine mammals under the MMPA.
Mitigation measures will be employed during USWTR activities to minimize potential effects to
the greatest extent practicable. As such, the potential exists for moderate, but recoverable effects
to occur to sea turtles and marine mammals from the introduction of sound into the environment.
However, with the implementation of proper mitigations, no significant impacts are anticipated.

### 4.3.1 Conceptual Biological Framework

The regulatory language of the MMPA and ESA requires that all anticipated responses to sound
resulting from Navy exercises in the USWTR be considered relative to their potential impact on
animal growth, survivability and reproduction. Although a variety of effects may result from an
acoustic exposure, not all effects will impact survivability or reproduction (e.g., short-term
changes in respiration rate would have no effect on survivability or reproduction). Whether an
effect significantly affects a marine mammal must be determined from the best available science
regarding marine mammal responses to sound.

A conceptual framework has been constructed (Figure 4.3-1) to assist in ordering and evaluating
the potential responses of marine mammals to sound. Although the framework is described in the
context of effects of sonars on marine mammals, the same approach could be used for fish,
turtles, sea birds, etc. exposed to other sound sources (e.g., impulsive sounds from explosions);
the framework need only be consulted for potential pathways leading to possible effects.
Conceptual Biological Framework Used to Order and Evaluate the Potential Responses of Marine Mammals to Sound

Figure 4.3-1
4.3.1.1 Organization

The framework is a “block diagram” or “flow chart,” organized from left to right, and grossly compartmentalized according to the phenomena that occur within each. These include the physics of sound propagation (Physics block), the potential physiological responses associated with sound exposure (Physiology block), the behavioral processes that might be affected (Behavior block), and the life functions that may be immediately affected by changes in behavior at the time of exposure (Life Function – Proximate). These are extended to longer term life functions (Life Function – Ultimate) and into population and species effects.

Throughout the flow chart dotted and solid lines are used to connect related events. Solid lines are those items which “will” happen, dotted lines are those which “might” happen, but which must be considered (including those hypothesized to occur but for which there is no direct evidence). Blue dotted lines indicate instances of “feedback” — where the information flows back to a previous block. Some boxes are colored according to how they relate to the definitions of harassment in the MMPA, with red indicating Level A harassment (injury) and yellow indicating Level B harassment (behavioral disturbance) (see Subchapter 4.3.2.1).

The following sections describe the flowthrough of the framework, starting with the production of a sound, and flowing through marine mammal exposures, responses to the exposures, and the possible consequences of the exposure. Along with the description of each block an overview of the state of knowledge is described with regard to marine mammal responses to sound and the consequences of those exposures. Application of the conceptual framework to impact analyses and regulations defined by the MMPA and ESA are discussed in subsequent sections.

4.3.1.2 Physics Block

Sounds emitted from a source propagate through the environment to create a spatially variable sound field. To determine if an animal is “exposed” to the sound, the received sound level at the animal’s location is compared to the background ambient noise. An animal is considered exposed if the predicted received sound level (at the animal’s location) is above the ambient level of background noise. If the animal is determined to be exposed, two possible scenarios must be considered with respect to the animal’s physiology— responses of the auditory system and responses of non-auditory system tissues. These are not independent pathways and both must be considered since the same sound could affect both auditory and non-auditory tissues.

4.3.1.3 Physiology Block

4.3.1.3.1 Auditory System Response

The primary physiological effects of sound are on the auditory system (Ward, 1997). The mammalian auditory system consists of the outer ear, middle ear, inner ear, and central nervous system. Sound waves are transmitted through the outer and middle ears to fluids within the inner ear. The inner ear contains delicate electromechanical hair cells that convert the fluid motions
into neural impulses that are sent to the brain. The hair cells within the inner ear are the most vulnerable to overstimulation by noise exposure (Yost, 1994).

Potential auditory system effects are assessed by considering the characteristics of the received sound (e.g., amplitude, frequency, duration) and the sensitivity/susceptibility of the exposed animals. Some of these assessments can be numerically based, while others will be necessarily qualitative, due to lack of information, or will need to be extrapolated from other species for which information exists. Potential physiological responses to a sound exposure are discussed here in order of increasing severity, progressing from perception of sound to auditory trauma.

**4.3.1.3.1.1 No Perception**

The received level is not of sufficient amplitude, frequency, and duration to be perceptible to the animal; i.e., the sound is not audible. By extension, this cannot result in a stress response or a change in behavior.

**4.3.1.3.1.2 Perception**

Sounds with sufficient amplitude and duration to be detected within the background ambient noise are assumed to be perceived (i.e., sensed) by an animal. This category includes sounds from the threshold of audibility through the normal dynamic range of hearing. To determine whether an animal perceives the sound, the received level, frequency, and duration of the sound are compared to what is known of the species’ hearing sensitivity. Within this conceptual framework, a sound capable of auditory masking, auditory fatigue, or trauma is assumed to be perceived by the animal.

Information on hearing sensitivity exists for approximately 25 of the nearly 130 species of marine mammals. Within the cetaceans, these studies have focused primarily on odontocete species (e.g., Szymanski et al., 1999; Kastelein et al., 2002a; Nachtigall et al., 2005; Yuen et al., 2005; Houser and Finneran, 2006). Because of size and availability, direct measurements of mysticete whale hearing are nearly non-existent (Ridgway and Carder, 2001). Measurements of hearing sensitivity have been conducted on species representing all of the pinniped families (Phocidae, Otariidae, Odobenidae) (Schusterman et al., 1972; Moore and Schusterman, 1987; Terhune, 1988; Thomas et al., 1990; Turnbull and Terhune, 1990; Kastelein et al., 2002b; Wolski et al., 2003; Kastelein et al., 2005b). Hearing sensitivity measured in these studies can be compared to the amplitude, duration and frequency of a received sound, as well as the ambient environmental noise, to predict whether or not an exposed marine mammal will perceive a sound to which it is exposed.

The features of a perceived sound (e.g., amplitude, frequency, duration, temporal pattern) are also used to judge whether the sound exposure is capable of producing a stress response (see Subchapter 4.3.1.3.3). Factors to consider in this decision include the probability of the animal being naïve or experienced with the sound (i.e., what are the known/unknown consequences, to the animal, of the exposure). Although preliminary because of the small numbers of samples
collected, different types of sounds (impulsive vs. continuous broadband vs. continuous tonal) have been shown to produce variable stress responses in marine mammals. Belugas demonstrated no catecholamine response (e.g., increased adrenalin production) to the playback of oil drilling sounds (Thomas et al., 1990) but showed an increase in catecholamines following exposure to impulsive sounds produced from a seismic watergun (Romano et al., 2004). A dolphin, exposed to the same seismic watergun signals, did not demonstrate a catecholamine response but did demonstrate an elevation in aldosterone, a hormone that has been suggested as being a significant indicator of stress in odontocetes (St. Aubin and Geraci, 1989; St. Aubin et al., 2001). Increases in heart rate were observed in dolphins to which conspecific calls were played, although no increase in heart rate was observed when tank noise was played back (Miksis et al., 2001). Collectively these results suggest a variable response that depends on the characteristics of the received signal and prior experience with the received signal.

Audible natural and artificial sounds can potentially result in auditory masking, a condition that occurs when a sound interferes with an animal’s ability to hear other sounds. 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. It is important to distinguish auditory fatigue, which persists after the sound exposure, from masking, which occurs during the sound exposure. Auditory masking experiments have been performed in pinnipeds (Southall et al., 2000; Southall et al., 2003) and in odontocetes engaged in active echolocation and passive listening tasks (Johnson, 1971; Au and Pawloski, 1989; Erbe, 2000). These studies provide baseline information from which the probability of masking can be estimated. The potential impact to a marine mammal depends on the type of signal that is being masked; important cues from conspecifics, signals produced by predators, or interference with echolocation are likely to have a greater impact on a marine mammal when they are masked than will a sound of little biological consequence.

Unlike auditory fatigue, which always results in a localized stress response (see Subchapter 4.3.1.3.3) because the sensory tissues are being stimulated beyond their normal physiological range, masking may or may not result in a stress response, depending on the degree and duration of the masking effect and the signal that is being masked. Masking may also result in a unique circumstance where an animal’s ability to detect other sounds is compromised without the animal’s knowledge. This could conceivably result in sensory impairment and subsequent behavior change; in this case the change in behavior is the lack of a response that would normally be made if sensory impairment did not occur. For this reason masking may lead directly to behavior change without first causing a stress response.

The proposed USWTR areas are on the continental shelf away from harbors or heavily traveled shipping lanes. The most intense underwater sounds in the proposed action area are those produced by active sonars and other acoustic sources that are in the mid-frequency or higher range. The sonar signals are likely within the audible range of most cetaceans, but are very limited in the temporal, frequency, and spatial domains. In particular, the pulse lengths are short, the duty cycle low, the total number of hours of operation per year small, and the MFA sonars transmit within a narrow band of frequencies (typically less than one-third octave). Finally, high
levels of sound are confined to a volume around the source and are constrained by attenuation at mid- and high-frequencies, as well as by limited beam widths and pulse lengths. For these reasons, the likelihood of sonar operations causing masking effects is considered negligible in this OEIS/EIS.

4.3.1.3.1.3 Auditory Fatigue

The most familiar effect of exposure to high intensity sound is reduction in hearing sensitivity, meaning an increase in the hearing threshold. This phenomenon is called a noise-induced threshold shift (NITS), or simply a threshold shift (TS) (Miller, 1974). A TS may be either permanent, in which case it is called a permanent threshold shift (PTS), or temporary, in which case it is called a temporary threshold shift (TTS). The distinction between PTS and TTS is based on whether there is a complete recovery of a TS following a sound exposure. If the TS eventually returns to zero (the threshold returns to the preexposure value), the TS is a TTS. If the TS does not return to zero but leaves some finite amount of TS, then that remaining TS is a PTS. Figure 4.3-2 shows one hypothetical TS that completely recovers, a TTS, and one that does not completely recover, leaving some PTS.

Although both auditory trauma and fatigue may result in reduction in hearing sensitivity, the mechanisms responsible for auditory fatigue differ from auditory trauma and would primarily consist of metabolic fatigue and exhaustion of the hair cells and cochlear tissues. Note that the term “auditory fatigue” is often used to mean “TTS”; however, in this OEIS/EIS we use a more general meaning to differentiate fatigue mechanisms (e.g., metabolic exhaustion and distortion of tissues) from trauma mechanisms (e.g., physical destruction of cochlear tissues occurring at the time of exposure). Auditory fatigue may result in PTS or TTS but is always assumed to result in a stress response. The actual amount of threshold shift depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure.

![Two Hypothetical Threshold Shifts](image)

There are no PTS data for cetaceans; however, a number of investigators have measured TTS in cetaceans (Schlundt et al., 2000, 2006; Finneran et al., 2002, 2005, 2007; Nachtigall et al., 2003,
In these studies, hearing thresholds were measured in trained dolphins and belugas before and after exposure to intense sounds. Some of the more important data obtained from these studies are onset-TTS levels – exposure levels sufficient to cause a just-measurable amount of TTS, often defined as 6 dB of TTS (see Schlundt et al., 2000). The existing cetacean TTS data show that, for the species studied and (non-impulsive) mid-frequency sounds of interest in this OEIS/EIS, the following are true:

- **The growth and recovery of TTS are analogous to those in land mammals.** This means that, as in land mammals, cetacean TSs depend on the amplitude, duration, frequency content, and temporal pattern of the sound exposure. Threshold shifts will generally increase with the amplitude and duration of sound exposure. For continuous sounds, exposures of equal energy will lead to approximately equal effects (Ward, 1997). For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur during the quiet period between exposures) (Kryter et al., 1966; Ward, 1997).

- **Sound pressure level (SPL) by itself is not a good predictor of onset-TTS, since the amount of TTS depends on both SPL and duration.**

- **Sound exposure level (SEL) is correlated with the amount of TTS and is a good predictor for onset-TTS from single, continuous exposures with variable durations.** This agrees with human TTS data presented by Ward et al., (1958, 1959).

The most relevant TTS data for analyzing the effects of MFA and high-frequency active (HFA) sonars are from Schlundt et al. (2000, 2006) and Finneran et al. (2005). These studies provided onset-TTS exposures for multiple subjects at 3, 10, and 20 kHz. The data point to an SEL of 195 dB re 1 μPa^2^-s as the most appropriate predictor for onset-TTS in dolphins and belugas from a single, continuous exposure in the mid-frequency range. This finding is supported by the recommendations of a panel of scientific experts formed to study the effects of sound on marine mammals (Southall et al., 2007). More recent TTS data at 20 kHz (Finneran et al., 2007) revealed larger amounts of TTS compared to 3 kHz exposures with the same SEL. However, these data are not used here because (1) the relatively long duration exposures (48-64 seconds) may have contributed to the observed differences and (2) the data are from a single subject. For these reasons, an SEL of 195 dB re 1 μPa^2^-s remains the best available prediction for the onset of TTS from MFA or HFA sonar.

In contrast to TTS data, PTS data do not exist and are unlikely to be obtained for marine mammals. Differences in auditory structures and the way that sound propagates and interacts with tissues prevent terrestrial mammal PTS thresholds from being directly applied to marine mammals; however, the inner ears of marine mammals are analogous to those of terrestrial mammals. Experiments with marine mammals have revealed similarities between marine and terrestrial mammals with respect to features such as TTS, age-related reduction in hearing...
sensitivity, ototoxic drug-induced reduction in hearing sensitivity, masking, and frequency selectivity. Therefore, in the absence of marine mammal PTS data, onset-PTS exposure levels may be estimated from marine mammal TTS data and PTS/TTS relationships observed in terrestrial mammals. This involves:

- estimating the largest amount of TTS that may be induced without PTS. Exposures causing a TS greater than this value are assumed to cause PTS.
- estimating the additional exposure, above the onset-TTS exposure, necessary to reach the maximum allowable amount of TTS (assumed here to indicate PTS). This requires estimating the growth rate of TTS – how much additional TTS is produced by an increase in exposure level.

A variety of terrestrial mammal data sources indicate that TSs up to 40 to 50 dB may be induced without PTS, and that 40 dB is a reasonable upper limit for TS to prevent PTS (Ward et al., 1958, 1959, 1960; Miller et al., 1963; Kryter et al., 1966). A conservative assumption is that continuous-type exposures producing TSs of 40 dB or more always result in some amount of PTS.

The TTS growth rate as a function of SEL is nonlinear; the growth rate at small amounts of TTS is less than the growth rate at larger amounts of TTS. In other words, the curve relating TTS and SEL is not a straight line but a curve that becomes steeper as SEL and TTS increase. This means that the relatively small amounts of TTS produced in marine mammal studies limit the applicability of these data to estimate the TTS growth rate — since the amounts of TTS are generally small the TTS growth rate estimates would likely be too low. Fortunately, data exist for the growth of TTS in terrestrial mammals at higher amounts of TTS. Data from Ward et al. (1958, 1959) reveal a linear relationship between TTS and SEL, with growth rates of 1.5 to 1.6 dB TTS per dB increase in SEL. Since there is a 34 dB TS difference between onset-TTS (6 dB) and onset-PTS (40 dB), the additional exposure above onset-TTS that is required to reach PTS would be 34 dB divided by 1.6 dB/db, or approximately 20 dB. Therefore, exposures with SELs 20 dB above those producing TTS may be assumed to produce a PTS. For an onset-TTS exposure with SEL = 195 dB re 1 μPa²-s, the estimate for onset-PTS would be 215 dB re 1 μPa²-s. This extrapolation process and the resulting TTS prediction is identical to that recently proposed by a panel of scientific experts formed to study the effects of sound on marine mammals (Southall et al., 2007). The method predicts larger (worse) effects than have actually been observed in tests on a bottlenose dolphin [Schlundt et al. (2006) reported a TTS of 23 dB (no PTS) in a bottlenose dolphin exposed to a 3 kHz tone with an SEL = 217 dB re 1 μPa²-s].
4.3.1.3.1.4 Auditory Trauma

Auditory trauma represents 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. The potential for trauma is related to the frequency, duration, onset time and received sound pressure as well as the sensitivity of the animal to the sound frequencies. Because of these interactions, the potential for auditory trauma will vary among species. Auditory trauma is always injurious, but could be temporary and not result in permanent reduction in hearing sensitivity. Auditory trauma is always assumed to result in a stress response.

Relatively little is known about auditory system trauma in marine mammals resulting from known sound exposure. A single study spatially and temporally correlated the occurrence of auditory system trauma in humpback whales with the detonation of a 5,000 kg explosive (Ketten et al., 1993). The exact magnitude of the exposure in this study cannot be determined and it is possible that the trauma was caused by the shock wave produced by the explosion (which would not be generated by a sonar). There are no known occurrences of direct auditory trauma in marine mammals exposed to MFA sonars.

4.3.1.3.2 Non-Auditory System Response

Potential impacts to tissues other than those related to the auditory system are assessed by considering the characteristics of the sound (e.g., amplitude, frequency, duration) and the known or estimated response characteristics of non-auditory tissues. Some of these assessments can be numerically based (e.g., exposure required for rectified diffusion). Others will be necessarily qualitative, due to lack of information on the mechanical properties of the tissues and their function. Each of the potential responses may or may not result in a stress response.

4.3.1.3.2.1 Direct Tissue Response

Direct tissue responses to sound stimulation may range from tissue trauma (injury) to mechanical vibration with no resulting injury. Any tissue injury would produce a stress response whereas non-injurious stimulation may or may not.

Resonance is a phenomenon that exists when an object is vibrated at a frequency near its natural frequency of vibration – the particular frequency at which the object vibrates most readily. The size and geometry of an air cavity determine the frequency at which the cavity will resonate. Displacement of the cavity boundaries during resonance has been suggested as a cause of injury. Large displacements have the potential to tear tissues that surround the air space (for example, lung tissue).

Understanding resonant frequencies and the susceptibility of marine mammal air cavities to resonance is important in determining whether certain sonars have the potential to affect different cavities in different species. In 2002, the NMFS convened a panel of government and
private scientists to address this issue (NOAA, 2002b). They modeled and evaluated the likelihood that Navy MFA sonars caused resonance effects in beaked whales that eventually led to their stranding (NOAA and DoN, 2001). The conclusions of that group were that resonance in air-filled structures was not likely to have caused the Bahamas stranding (NOAA, 2002b). The frequencies at which resonance was predicted to occur were below the frequencies utilized by the sonar systems employed. Furthermore, air cavity vibrations, even at resonant frequencies, were not considered to be of sufficient amplitude to cause tissue damage, even under the worst-case scenario in which air volumes would be undamped by surrounding tissues and the amplitude of the resonant response would be maximal. These same conclusions would apply to other actions involving MFA sonar.

4.3.1.3.2.2 Indirect Tissue Response

Based upon the amplitude, frequency, and duration of the sound, it must be assessed whether exposure is sufficient to indirectly affect tissues. For example, one suggested (indirect) cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. Under this hypothesis, one of three things could happen: (1) bubbles grow to the extent that tissue hemorrhage (injury) occurs; (2) bubbles develop to the extent that a complement immune response is triggered or the nervous system tissue is subjected to enough localized pressure that pain or dysfunction occurs (a stress response without injury); or (3) the bubbles are cleared by the lung without negative consequence to the animal. The probability of rectified diffusion, or any other indirect tissue effect, will necessarily be based upon what is known about the specific process involved.

Rectified diffusion is facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The dive patterns of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser et al., 2001b). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness (DCS). 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 the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size.

Recent research with \textit{ex vivo} supersaturated (bovine) tissues suggested that for a 37 kHz signal, a sound exposure of $\sim 215 \text{ dB re } 1 \mu \text{Pa}$ would be required before microbubbles became destabilized and grew (Crum et al., 2005). Assuming spherical spreading loss and a nominal sonar source level of 235 dB re 1 $\mu$Pa, a whale would need to be within 10 m (33 ft) of the sonar dome to be exposed to such sound levels. Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400-700 kPa for periods of hours and then releasing them to ambient conditions.
pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to the high pressures, levels of supersaturation in the tissues could have been as high 400-700%. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser et al., 2001b). It is improbable that this mechanism is responsible for stranding events or traumas associated with beaked whale strandings. Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

Yet another hypothesis has speculated that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson et al., 2003; Fernandez et al., 2005). This scenario is accounted for in the conceptual framework via a feedback path from the behavioral changes of “diving” and “avoidance” to the “indirect tissue response” block. In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Recent modeling suggests that even unrealistically rapid rates of ascent from normal dive behaviors are unlikely to result in supersaturation to the extent that bubble formation would be expected in beaked whales (Zimmer et al., 2007). Recently, Tyack et al. (2006) suggested that emboli observed in animals exposed to MFA sonar (Jepson et al., 2003; Fernandez et al., 2005) could stem instead from a behavioral response that involves repeated dives shallower than the depth of lung collapse. Given that nitrogen gas accumulation is a passive process (i.e., nitrogen is metabolically inert), a bottlenose dolphin was trained to repetitively dive a profile predicted to elevate nitrogen saturation to the point that nitrogen bubble formation was predicted to occur. However, inspection of the vascular system of the dolphin via ultrasound did not demonstrate the formation of any nitrogen gas bubbles (Houser et al., 2008).

There is considerable disagreement among scientists as to the likelihood of this phenomenon (Piantadosi and Thalmann, 2004; Evans and Miller, 2003). Although it has been argued that traumas from recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson et al., 2003; Fernandez et al., 2005), nitrogen bubble formation as the cause of the traumas has not been verified. The presence of bubbles postmortem, particularly after decompression, is not necessarily indicative of bubble pathology. Prior experimental work has demonstrated the post-mortem presence of bubbles following decompression in laboratory animals can occur as a result of invasive investigative procedures (Stock et al., 1980).

Additionally, the fat embolic syndrome identified by Fernández et al. (2005) is the first of its kind in marine mammals. The pathogenesis of fat emboli formation is as yet undetermined and remains largely unstudied, and it would therefore be inappropriate to prematurely link it to nitrogen bubble formation. Because evidence of nitrogen bubble formation following a rapid ascent by beaked whales is arguable and requires further investigation, this DEIS makes no assumptions about it being the causative mechanism in beaked whale strandings associated with sonar operations. No similar findings to those found in beaked whales stranding coincident with sonar activity have been reported in other stranded animals following known exposure to sonar
operations. By extension, no marine mammals addressed in this OEIS/EIS are given differential treatment due to the possibility of acoustically mediated bubble growth.

4.3.1.3.3 No Tissue Response

The received sound is insufficient to cause either direct (mechanical) or indirect effects to tissues.

4.3.1.3.3 The Stress Response

The acoustic source is considered a potential stressor if by its action on the animal, via auditory or non-auditory means, it may produce a stress response in the animal. The term “stress” has taken on an ambiguous meaning in the scientific literature, but with respect to the conceptual framework and discussions of allostasis and allostatic loading in this OEIS/EIS, the stress response will refer to an increase in energetic expenditure that results from exposure to the stressor and which is predominantly characterized by either the stimulation of the sympathetic nervous system (SNS), the hypothalamic-pituitary-adrenal (HPA) axis (Reeder and Kramer, 2005), or through oxidative stress, as occurs in noise-induced reduction in hearing sensitivity (Henderson et al., 2006). The SNS response to a stressor is immediate and acute and is characterized by the release of the catecholamine neurohormones norepinephrine and epinephrine (i.e., adrenaline). These hormones produce elevations in the heart and respiration rate, increase awareness, and increase the availability of glucose and lipid for energy. The HPA response is ultimately defined by increases in the secretion of the glucocorticoid steroid hormones (e.g. cortisol, aldosterone). The amount of increase in circulating glucocorticoids above baseline may be an indicator of the overall severity of a stress response (Hennessy et al., 1979). Oxidative stress occurs when reactive molecules, called reactive oxygen species (ROS), are produced in excess of molecules that counteract their activity (i.e., antioxidants). The ROS are produced during normal physiological processes and are generally counterbalanced by enzymes and antioxidants. However, environmental stressors can result in an excess production of ROS, thus leading to damage of lipids, proteins, and nucleic acids at the cellular level (Berlett and Stadtman, 1997; Sies, 1997; Touyz, 2004). Each component of the stress response is variable in time; e.g., adrenalinies are released almost immediately and are used or cleared by the system quickly, whereas glucocorticoid levels may take long periods of time to return to baseline.

The presence and magnitude of a stress response in an animal depends on a number of factors. These include the animal’s life history stage (e.g., neonate, juvenile, adult), the environmental conditions, reproductive or developmental state, and experience with the stressor. Not only will these factors be subject to individual variation, but they will also vary within an individual over time. Prior experience with a stressor may be of particular importance as repeated experience with a stressor may dull the stress response via acclimation (St. Aubin and Dierauf, 2001). In considering potential stress responses of marine mammals to acoustic stressors, each of these should be considered. For example, is the acoustic stressor in an area where animals engage in breeding activity? Are animals in the region resident and likely to have experience with the stressor (i.e., repeated exposures)? Is the region a foraging ground or are the animals passing
through it transients? What is the ratio of young (naïve) to old (experienced) animals in the population? It is unlikely that all such questions can be answered from empirical data; however, they should be addressed in any qualitative assessment of a potential stress response as based on the available literature.

Marine mammals naturally experience stressors within their environment and as part of their 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 mammal experiences. In some cases, naturally occurring stressors can have profound impacts on marine mammals; e.g., chronic stress, as observed in stranded animals with long-term debilitating conditions (e.g., disease), has been demonstrated to result in an increased size of the adrenal glands and an increase in the number of epinephrine-producing cells (Clark et al., 2006). Anthropogenic activities have the potential to provide additional stressors above and beyond those that occur naturally. Potential stressors resulting from anthropogenic activities must be considered not only as to their direct impact on the animal but also as to their cumulative impact with environmental stressors already experienced by the animal.

Studies on the stress response of odontocete cetaceans to acute acoustic stimuli were previously discussed (Subchapter 4.3.1.3.1; Thomas et al., 1990; Miksis et al., 2001; Romano et al., 2004). Other types of stressors include the presence of vessels, fishery interactions, acts of pursuit and capture, the act of stranding, and pollution. In contrast to the limited amount of work performed on stress responses resulting from sound exposure, a considerably larger body of work exists on stress responses associated with pursuit, capture, handling and stranding. Pursuit, capture and short-term holding of belugas have been observed to result in a decrease in thyroid hormones (St. Aubin and Geraci, 1988) and increases in epinephrine (St. Aubin and Dierauf, 2001). In dolphins the trend is more complicated with the duration of the handling time potentially contributing to the magnitude of the stress response (St. Aubin et al., 1996; Ortiz and Worthy, 2000; St. Aubin, 2002). Elephant seals demonstrate an acute cortisol response to handling, but do not demonstrate a chronic response; on the contrary, adult females demonstrate a reduction in the adrenocortical response following repetitive chemical immobilization (Engelhard et al., 2002). With respect to anthropogenic sound as a stressor, the current limited body of knowledge will require extrapolation from species for which information exists to those for which no information exists.

The stress response may or may not result in a behavioral change, depending on the characteristics of the sound and the experience, gender and life history stage of the exposed animal. However, provided a stress response occurs, it is assumed that some contribution is made to the animal’s allostatic load. Allostasis is the ability of an animal to maintain stability through change by adjusting its physiology in response to both predictable and unpredictable events (McEwen and Wingfield, 2003). The same hormones associated with the stress response vary naturally throughout an animal’s life providing support for particular life history events (e.g., pregnancy) and predictable environmental conditions (e.g., seasonal changes). The allostatic load is the cumulative cost of allostasis incurred by an animal and is generally characterized with respect to an animal’s energetic expenditure. Perturbations to an animal which may occur with
the presence of a stressor, either biological (e.g., predator) or anthropogenic (e.g., construction), can contribute to the allostatic load (Wingfield, 2003). Additional costs are cumulative and additions to the allostatic load over time may contribute to reductions in the probability of achieving ultimate life history functions (e.g., survival, maturation, reproductive effort and success) by producing pathophysiological states. The contribution to the allostatic load from a stressor requires estimating the magnitude and duration of the stress response as well as any secondary contributions that might result from a change in behavior (see below).

If the acoustic source does not produce tissue effects, is not perceived by the animal, or does not produce a stress response by any other means, the conclusion from within the conceptual framework is that the exposure does not contribute to the allostatic load. Additionally, without a stress response or auditory masking, it is assumed that there is no change in behavior. Conversely, any immediate effect of exposure that produces an injury (i.e., red boxes on the flow chart) or auditory fatigue is assumed, within this OEIS/EIS, to produce a stress response and to contribute to the allostatic load.

4.3.1.3.4 Behavior Block

Acute stress responses may or may not result in a behavioral reaction. However, all changes in behavior are expected to result from an acute stress response. This expectation is conservatively based on the assumption that some form of physiological trigger must exist for an anthropogenic stimulus to alter a biologically significant behavior that is already being performed. The exception to this rule is the case of masking. The presence of a masking sound may not produce a stress response, but may interfere with the animal’s ability to detect and discriminate biologically relevant signals. The inability to detect and discriminate biologically relevant signals hinders the potential for normal behavioral responses to auditory cues and is thus considered a behavioral change (see Subchapter 4.3.1.3.1.2).

Numerous behavioral changes can occur as a result of stress responses resulting from acoustic exposure and the flow chart lists only those that might be considered the most common types of response for a marine animal. For each potential behavioral change, the magnitude of the change and the severity of the response need to be estimated. Certain conditions, such as a flight response, might have a probability of resulting in injury. For example, a flight response, if of sufficient magnitude, could lead to a stranding event. Under the MMPA such an event precipitated by anthropogenic noise would be considered a Level A harassment (see Subchapter 4.3.2.1). Each altered behavior may also have the potential to disrupt biologically significant events (e.g., breeding or nursing) and may need to be qualified as Level B harassment (see Subchapter 4.3.2.1). All behavioral disruptions also have the potential to contribute to the allostatic load. This secondary potential is signified by the feedback from the collective behaviors to allostatic loading (physiology block).

The response of a marine mammal to an anthropogenic sound will depend on the frequency content, duration, temporal pattern and amplitude of the sound as well as the animal’s prior experience with the sound and the context in which the sound is encountered (i.e., what the
animal is doing at the time of the exposure). The direction of the responses can vary, with some changes resulting in either increases or decreases from baseline (e.g., decreased dive times and increased respiration rate). Responses can also overlap; for example, an increased respiration rate is likely to be coupled to a flight response. Differential responses between and within species are expected since hearing ranges vary across species and the behavioral ecology of individual species is unlikely to completely overlap.

A review of marine mammal responses to anthropogenic sound was first conducted by Richardson and others (1995). A more recent review (Nowacek et al., 2007) addresses studies conducted since 1995 and focuses on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. The following sections provide a very brief overview of the state of knowledge of behavioral responses as they are listed in Fig. 4.3-1. The overviews focus on studies conducted since 2000 but are not meant to be comprehensive; rather, they provide an idea of the variability in behavioral responses that would be expected given the differential sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Estimates of the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species, or extrapolated from closely related species when no information exists.

**Flight Response** – A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exists, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with sonar activities (NOAA and DoN, 2001).

**Response to Predator** – Evidence suggests that at least some marine mammals have the ability to acoustically identify potential predators. For example, harbor seals that reside in the coastal waters off British Columbia are frequently targeted by certain groups of killer whales, but not others. The seals discriminate between the calls of threatening and non-threatening killer whales (Deecke et al., 2002), a capability that should increase survivorship while reducing the energy required for attending to and responding to all killer whale calls. The occurrence of masking or hearing impairment provides a means by which marine mammals may be prevented from responding to the acoustic cues produced by their predators. Whether or not this is a possibility depends on the duration of the masking/hearing impairment and the likelihood of encountering a predator during the time that predator cues are impeded.

**Diving** – Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive. Variations in dive behavior may reflect interruptions in biologically significant activities (e.g., foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (e.g., increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a
variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek et al. (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, an action, they noted, that could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach and speed of approach, seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low frequency signals of the ATOC sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa et al., 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the equivocal nature of behavioral effects and consequent difficulty in defining and predicting them.

Due to past incidents of beaked whale strandings associated with sonar operations, a feedback path is provided within the conceptual framework (Fig. 4.3-1) to provide a link between avoidance and diving and indirect tissue effects. This feedback accounts for the hypothesis that variations in diving behavior and/or avoidance responses can possibly result in nitrogen tissue supersaturation and nitrogen off-gassing, possibly to the point of deleterious vascular bubble formation (Jepson et al., 2003). Although hypothetical, the potential process is controversial and under debate in the scientific community; see Subchapter 4.3.1.3.2.2 for a discussion of this issue.

**Foraging** - Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (e.g., bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior in western gray whales off the coast of Russia (Yazvenko et al., 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen et al., 2006). Balaenopterid whales exposed to moderate low-frequency signals similar to the ATOC sound source demonstrated no variation in foraging activity (Croll et al., 2001b), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek et al., 2004). Although the received sound pressure level at the animals was similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response. A determination of whether foraging disruptions incur fitness consequences will require information on or estimates of the energetic requirements
of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

**Breathing** – Respiration naturally varies with different behaviors and variations in respiration rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to the whale feeding grounds (Gailey et al., 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms (Kastelein et al., 2001; Kastelein et al., 2006a) and emissions for underwater data transmission (Kastelein et al., 2005b). However, exposure of the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein et al., 2006a), again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

**Social relationships** - Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Disruption of social relationships therefore depends on the disruption of other behaviors (e.g., avoidance, masking, etc.) and no specific overview is provided here. However, social disruptions must be considered in context of the relationships that are affected. Long-term disruptions of mother/calf pairs or mating displays have the potential to affect the growth and survival or reproductive effort/success of individuals, respectively.

**Vocalizations** - Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. For example, in the presence of low frequency active (LFA) sonar, humpback whales have been observed to increase the length of their ‘songs’ (Miller et al., 2000; Fristrup et al., 2003), possibly due to the overlap in frequencies between the whale song and the LFA sonar. A similar compensatory effect for the presence of low frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al., 2007). Modification of multiple vocalization parameters has been shown in belugas residing in an area known for high levels of commercial traffic. These animals decreased their call rate, increased certain types of calls, and shifted upward in frequency content in the presence of small vessel noise (Lesage et al., 1999). Another study detected a measurable increase in the amplitude of their vocalizations when ships were present (Scheifele et al., 2005). Killer whales off the northwestern coast of the U.S. have been observed to increase the duration of primary calls once a threshold in observing vessel density (e.g., whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote et al., 2004). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles et al., 1994), although it cannot be absolutely determined whether
the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Avoidance - Avoidance is the displacement of an individual from an area as a result of the presence of a sound. It is qualitatively different from the flight response in its magnitude (i.e., directed movement, rate of travel, etc.). Oftentimes avoidance is temporary, and animals return to the area once the noise has ceased. Longer term displacement is possible, however, which can lead to changes in abundance or distribution patterns of the species in the affected region if they do not become acclimated to the presence of the sound (Blackwell et al., 2004; Bejder et al., 2006; Teilmann et al., 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein et al., 2001; Finneran et al., 2003; Kastelein et al., 2006a,b). Short term avoidance of seismic surveys, low frequency emissions, and acoustic deterrents have also been noted in wild populations of odontocetes (Bowles et al., 1994; Goold, 1996; 1998; Stone et al., 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey et al., 2007), while longer term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to be due to the presence of chronic vessel noise (Haviland-Howell et al., 2007; Miksis-Olds et al., 2007).

Resting and Orientation - A shift in an animal’s resting state or an attentional change via an orienting response represent behaviors that would be considered mild disruptions if occurring alone, and thus are placed at the bottom of the framework behavior list. As previously mentioned, the responses may co-occur with other behaviors – e.g. an animal may initially orient toward a sound source, and then move away from it. Thus, any orienting response should be considered in context of other reactions that may occur.

4.3.1.3.5 Life Function

Proximate life history functions are the functions that the animal is engaged in at the time of acoustic exposure. The disruption of these functions, and the magnitude of the disruption, must be considered in determining how the ultimate life history functions are affected. Consideration of the magnitude of the impact to each of the proximate life history functions depends on the life stage of the animal. For example, an animal on a breeding ground which is sexually immature will suffer relatively little consequence to disruption of breeding behavior when compared to an actively displaying adult of prime reproductive age.

The ultimate life functions are those which enable an animal to contribute to the population (or stock, or species, etc.) and which relate to the animal’s fitness (see Subchapter 4.3.2.2). The impact to ultimate life functions will depend on the nature and magnitude of the perturbation to proximate life history functions. Depending on the severity of the response to the stressor, acute perturbations may have nominal to profound impacts on ultimate life functions. Assessment of the magnitude of the stress response from a chronic perturbation would require an understanding of how and whether animals acclimate to a specific, repeated stressor and whether a chronic stress response occurs and results in subsequent fitness deficits.
The proximate life functions are loosely ordered in decreasing severity of impact. Mortality (Survival) has an immediate impact in that no future reproductive success is feasible and there is no further addition to the population resulting from reproduction. Severe injuries may also lead to reduced survivorship (longevity) and prolonged alterations in behavior. The latter may further affect an animal’s overall reproductive success and reproductive effort. Disruptions of breeding have an immediate impact on reproductive effort and may impact reproductive success. The magnitude of the effect will depend on the duration of the disruption and the type of behavior change that was provoked. Disruptions to feeding and migration can affect all of the ultimate life functions; however, the impacts to reproductive effort and success are not likely to be as severe or immediate as those incurred by mortality and breeding disruptions.

**4.3.1.3.6 Population and Species Effects**

The number of animals affected by exposure to sound and the magnitude of the impact to proximate life history functions must be assessed to determine the overall impact to ultimate life history functions. In turn, these impacts must be compared to population or species-level rates of reproduction to determine whether the impacts will affect rates of replacement within the population to which the animals belong. This process must be performed for animals listed under the ESA. Subchapters 4.3.8 and 4.3.9 discuss population and species effects related to listed marine mammals in the proposed USWTR locations.

**4.3.2 The Regulatory Framework**

To complete the acoustic effects analysis, the **conceptual framework** (Subchapter 4.3.1) must be related to the existing **regulatory frameworks** of the ESA and MMPA. The following sections describe the relationship between analyses conducted within the conceptual framework and regulations established by the MMPA and ESA. Information on the MMPA and ESA may be found in subchapters 1.6.1 and 1.6.2.

**4.3.2.1 MMPA Harassment**

For military readiness activities, **MMPA Level A harassment** includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild. Injury, as defined in this OEIS/EIS and previous rulings (NOAA, 2001, 2002a), is the destruction or loss of biological tissue. Consistent with prior actions and rulings (NOAA, 2001), this OEIS/EIS assumes that all injuries (slight to severe) are considered Level A harassment under the MMPA.

For military readiness activities, **MMPA Level B harassment** includes all actions that disturb or are likely to disturb a marine mammal or marine mammal stock in the wild through the disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered.
The areas of ocean in which Level A and Level B harassment are predicted to occur are described as harassment zones. The Level A harassment zone extends from the source out to the distance and exposure at which the slightest amount of injury is predicted to occur. The acoustic exposure that produces the slightest degree of injury is therefore the threshold value defining the outermost limit of the Level A harassment zone. Use of the threshold associated with the onset of slight injury as the most distant point and least injurious exposure takes account of all more serious injuries by inclusion within the Level A harassment zone. The threshold used to define the outer limit of the Level A harassment zone is given in Subchapter 4.3.3.1. The Level B harassment zone begins just beyond the point of slightest injury and extends outward from that point to include all animals with the potential to experience Level B harassment. The animals predicted to be in the portion of the zone where temporary impairment of sensory function (altered physiological function) is expected are all assumed to experience Level B harassment because of the potential impediment of behaviors that rely on acoustic cues. Beyond that distance, the Level B harassment zone continues to the point at which no behavioral disruption is expected to occur. The criterion and threshold used to define the outer limit of the Level B harassment zone are given in Subchapter 4.3.3.2.

Because the tissues of the ear appear to be the most susceptible to the physiological effects of sound and TSs tend to occur at lower exposures than other more serious auditory effects, PTS and TTS are used in this OEIS/EIS as biological indicators of physiological responses that qualify as harassment.

PTS is non-recoverable and, by definition, must result from the destruction of tissues within the auditory system. PTS therefore qualifies as an injury and is classified as Level A harassment under the wording of the MMPA. In this OEIS/EIS, the smallest amount of PTS (onset-PTS) is taken to be the indicator for the smallest degree of injury that can be measured. The acoustic exposure associated with onset-PTS is used to define the outer limit of the Level A harassment zone.

TTS is recoverable and, as in recent rulings (NOAA 2001, 2002a), is considered to result from the temporary, non-injurious distortion of hearing-related tissues. In this OEIS/EIS, the smallest measurable amount of TTS (onset-TTS) is taken as the best indicator for slight temporary sensory impairment. Because it is considered non-injurious, the acoustic exposure associated with onset-TTS is used to define the outer limit of the portion of the Level B harassment zone attributable to a physiological impairment, and within which all animals are assumed to incur Level B harassment. This follows from the concept that temporary reductions in hearing sensitivity can potentially affect an animal’s ability to react normally to the sounds around it. Therefore, in this OEIS/EIS the potential for TTS is considered as a Level B harassment that is mediated by a physiological effect upon the auditory system.

At exposure levels below those which can cause TTS, animals may respond to the sound and alter their natural behaviors. Whether or not these alterations result in “a potential for a significant behavioral change or response in a biologically important behavior or activity” depends on the physical characteristics of the sound (e.g., amplitude, frequency characteristics,
temporal pattern, duration, etc.) as well as the animal’s experience with the sound, the context of the exposure (e.g., what is the animal doing at the time of the exposure), and the animal’s life history stage. Responses will be species-specific and must consider the acoustic sensitivity of the species. In this OEIS/EIS a **risk function (Subchapter 4.3.3.2)** is used to determine the outer limit of the portion of the Level B harassment zone attributable to significant changes in biologically important behaviors, but which is not a function of TTS. The risk function defines a probability of a significant change in biologically important behaviors as a function of the received sound pressure level. This follows from the concept that the probability of a behavioral response will generally decline as a function of decreasing exposure level.

Figure 4.3-3 is a visual depiction of the MMPA acoustic effects framework used in this OEIS/EIS. The areas of ocean in which Level A and Level B harassment are predicted to occur are described as harassment zones. (This figure is intended to illustrate the general relationships between harassment zones and does not represent the sizes or shapes of the actual harassment zones for this OEIS/EIS.) The Level A harassment zone extends from the source out to the distance and exposure where onset-PTS is predicted to occur. The Level B harassment zone begins just beyond the point of onset-PTS and extends outward to the distance and exposure where no (biologically significant) behavioral disruption is expected to occur. The Level B harassment zone includes both the region in which TTS is predicted to occur and the region in which significant non-TTS behavioral responses are predicted to occur. Criteria and thresholds used to define the outer limits of the Level A and Level B harassment zones are given in Subchapters 4.3.3.

### 4.3.2.2 ESA Harm

Sound exposure criteria and thresholds relevant to MMPA regulations were developed using the MMPA Level A and Level B definitions. Regulations established by the ESA establish different criteria for determining impacts to animals covered by the ESA.

- ESA regulations define harm as “an act which actually kills or injures” fish or wildlife (50 CFR 222.102). Based on this definition, the criteria and thresholds developed to estimate MMPA Level A harassment zones are also used to provide an initial assessment of the potential for harm under the ESA. The Level A harassment criterion applied here is the slightest measurable degree of tissue injury. If any ESA-listed marine mammals are predicted to be within the Level A harassment zone, these species are considered to potentially experience ESA harm (Subchapter 4.3.8).
Summary of the Acoustic Effect Framework Used in This OEIS/EIS

Notes:
(A) General relationships between PTS, TTS, and risk function harassment zones. Image is not scaled, which allows each zone to be visible.
(B) Scaled representation of harassment zone areas. Scaled distances were based on a single, 1-second ping with source level of 235 dB re 1 μPa. Spherical spreading was used for the PTS and TTS zones. A 15 logR spreading relationship and absorption of 0.16 dB/km were used for the non-TTS calculations. See subchapter 4.3.3.1 for details of non-TTS effects.
Consistent with NMFS Section 7 analyses, the spatial and temporal overlap of naval activities with the presence of listed species is assessed. The density and distribution of age, gender, and life history stage of the species present are then considered with respect to the predicted number and types of behavioral reactions expected to occur as a result of the naval action. The potential for behavioral responses to affect the fitness of an individual is then determined; the fitness of the animal is generally related to the animal’s relative lifetime reproductive success. Disrupted factors that can impact an animal’s fitness include survival, growth, and reproductive effort or success. A reduction in an animal’s fitness may have the potential to contribute to an overall reduction in the abundance of a population by affecting the growth rate of the population to which it belongs.

In this OEIS/EIS, a risk function for estimating Level B harassment under the MMPA (see Subchapter 4.3.3.2.2) is used to first assess the number of acoustic exposures of marine mammals that could “possibly” affect the fitness of an individual. For each species, the relationship between the exposure values and predicted behavioral responses are then compared against the predicted distribution of age, gender and life history stage of the exposed animals. Next, a determination is made as to whether behavioral responses will have a fitness consequence to the animals. Finally, a determination is made as to whether the cumulative cost to the fitness of the individuals is likely to adversely affect the population’s viability.

Results of the acoustic effects modeling are evaluated with respect to the species density inputs to the model to determine if the sound exposures predicted by the model are expected to occur on the USWTR site. Details of the predicted exposure levels (e.g., number, duration, and sound pressure level of received pings), species density and distribution information, species life history information, and the conceptual biological framework are then consulted to evaluate the potential for harm as defined in NMFS ESA regulations. Details of this evaluation are provided in Subchapter 4.3.7.

### 4.3.3 Criteria and Thresholds for MMPA Harassment – PTS and TTS

In this OEIS/EIS, sound exposure thresholds for TTS and PTS are:

- **195 dB re 1 \(\mu Pa^2\)-s received SEL for TTS**
- **215 dB re 1 \(\mu Pa^2\)-s received SEL for PTS**

A marine mammal predicted to receive a sound exposure with SEL of 215 dB re 1 \(\mu Pa^2\)-s or greater is assumed to experience PTS and is counted as a Level A harassment. A marine mammal predicted to receive a sound exposure with SEL greater than or equal to 195 dB re 1 \(\mu Pa^2\)-s is counted as a Level B harassment.
μPa²-s but less than 215 dB re 1 μPa²-s is assumed to experience TTS and is counted as Level B harassment. The only exceptions to this approach are for a limited number of species where the predicted sound exposure is not expected to occur, due to substantial differences in the expected species presence at a specific USWTR site versus the modeled density inputs for the larger OPAREAS. Sections 4.3.8 and 4.3.9 contain analyses for each individual species at each of the USWTR alternative sites.

**Derivation of Effect Thresholds**

The onset-TTS threshold is primarily based on the cetacean TTS data from Schlundt et al. (2000). Since these tests used short-duration tones similar to sonar pings, they are the most directly relevant data for this OEIS/EIS. The mean SEL required to produce onset-TTS in these tests was 195 dB re 1 μPa²-s. This result is corroborated by the mid-frequency tone data of Finneran et al. (2005) and Schlundt et al. (2006) and the long-duration noise data from Nachtigall et al. (2003, 2004). Together, these data demonstrate that TTS in cetaceans is correlated with the received SEL and that onset-TTS exposures are fit well by an equal-energy line passing through 195 dB re 1 μPa²-s.

The onset-PTS threshold is based on a 20 dB increase in SEL over that required for onset-TTS. The 20 dB value is based on estimates from terrestrial mammal data of PTS occurring at 40 dB or more of TS, and on TS growth occurring at a rate of 1.6 dB/dB increase in SEL (see Subchapter 4.3.1.3). This estimate is conservative because (1) 40 dB of TS is actually an upper limit for TTS used to approximate onset-PTS; (2) the 1.6 dB/dB growth rate is the highest observed in the data from Ward et al. (1958, 1959) and larger than that experimentally observed in dolphins; and (3) a bottlenose dolphin exposed to a 3 kHz tone at 217 dB re 1 μPa²-s experienced only TTS and no permanent effects (Schlundt et al., 2006).

**Mysticetes and Odontocetes**

Information on auditory function in mysticetes is extremely lacking. Sensitivity to low frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system. Baleen whales are estimated to hear from 15 Hz to 20 kHz, with good sensitivity from 20 Hz to 2 kHz (Ketten, 1998). An anatomic model of the right whale ear predicts functional range of hearing from 15 Hz to 18 kHz (Parks et al., 2007). Filter-bank models of the humpback whale’s ear suggest that humpbacks are sensitive to frequencies between 30 Hz and 18 kHz, with best sensitivity between 700 Hz and 10 kHz (Helweg et al., 2000; Houser et al., 2001a). However, absolute sensitivity has not been modeled for any baleen whale species (see Southall et al., 2007 for review). Furthermore, there is no indication of what sorts of sound exposure produce threshold shifts in these animals.

The criteria and thresholds for PTS and TTS developed for odontocetes in this OEIS/EIS are also used for mysticetes. This generalization is based on the assumption that the empirical data at hand are representative of both groups until data collection on mysticete species shows
otherwise. For the frequencies of interest in this OEIS/EIS, there is no evidence that the total amount of energy required to induce onset-TTS and onset-PTS in mysticetes is different than that required for odontocetes.

**Use of SEL for PTS/TTS Thresholds in this OEIS/EIS**

Thresholds for PTS/TTS are expressed in terms of total received SEL. SEL is a measure of the flow of sound energy through an area (see Appendix C). Marine and terrestrial mammal data show that, for continuous-type sounds (non-impulsive sounds) of interest in this OEIS/EIS, TTS and PTS are more closely related to the energy in the sound exposure than to the exposure SPL.

The SEL for each individual ping is calculated from the following equation:

$$SEL = SPL + 10 \log_{10}(\text{duration})$$

The SEL includes both the ping SPL and duration. Longer-duration pings and/or higher-SPL pings will have a higher SEL.

If an animal is exposed to multiple pings, the SEL in each individual ping is summed to calculate the total SEL (see Appendix C). Since mammals exhibit lower TSs from intermittent exposures compared to continuous exposures with the same energy (Ward, 1997), basing the thresholds on the total received SEL is a conservative approach for treating multiple pings; in reality, some recovery will occur between pings and lessen the severity of a particular exposure. Therefore, estimates in this OEIS/EIS are conservative because recovery is not taken into account – intermittent exposures are considered equivalent to continuous exposures.

The total SEL depends on the SPL, duration, and number of pings received. The TTS and PTS thresholds do not imply any specific SPL, duration, or number of pings. The SPL and duration of each received ping are used to calculate the total SEL and determine whether the received SEL meets or exceeds the effect thresholds. For example, the TTS threshold would be reached through any of the following exposures:

- A single ping with SPL = 195 dB re 1 μPa and duration = 1 second
- A single ping with SPL = 192 dB re 1 μPa and duration = 2 seconds
- Two pings with SPL = 192 dB re 1 μPa and duration = 1 second
- Two pings with SPL = 189 dB re 1 μPa and duration = 2 seconds.
Comparison to Surveillance Towed Array Sensor System Low-Frequency Active Risk Functions

The physiological effect thresholds described in this OEIS/EIS should not be confused with criteria and thresholds used for the Navy’s Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) sonar. SURTASS LFA features pings lasting many tens of seconds. The sonars of concern for use during USWTR activities emit pings lasting a few seconds at most. SURTASS LFA risk functions were expressed in terms of the received “single ping equivalent” SPL. Physiological effect thresholds in this OEIS/EIS are expressed in terms of the total received SEL. The SURTASS LFA risk function parameters cannot be directly compared to the effect thresholds used in the USWTR OEIS/EIS. Comparisons must take into account the differences in ping duration, number of pings received, and method of accumulating effects over multiple pings.

Previous Use of SEL for PTS/TTS

Energy measures have been used as a part of dual criteria for cetacean auditory effects in shock trials, which only involve impulsive-type sounds (DoN, 1997a, 2001a). These actions used 192 dB re 1 μPa²-s as a reference point to derive a TTS threshold in terms of SEL. A second TTS threshold, based on peak pressure, was also used. If either threshold was exceeded, effect was assumed.

The 192 dB re 1 μPa²-s reference point differs from the threshold of 195 dB re 1 μPa²-s used for TTS in this OEIS/EIS. The 192 dB re 1 μPa²-s value was based on the minimum observed by Ridgway et al. (DoN, 1997b) and Schlundt et al. (2000) during TTS measurements with bottlenose dolphins exposed to 1-second tones. At the time, no impulsive test data for marine mammals were available and the 1-second tonal data were considered to be the best available. The minimum value of the observed range of 192 to 201 dB re 1 μPa²-s was used to protect against misinterpretation of the sparse data set available. The 192 dB re 1 μPa²-s value was reduced to 182 dB re 1 μPa²-s to accommodate the potential effects of pressure peaks in impulsive waveforms.

The additional data now available for onset-TTS in small cetaceans confirm the original range of values and increase confidence in it (Finneran et al., 2005; Nachtigall et al., 2003, 2004; Schlundt et al., 2006). This OEIS/EIS, therefore, uses the more complete data available and the mean value of the entire Schlundt et al. (2000) data set (195 dB re 1 μPa²-s), instead of the minimum of 192 dB re 1 μPa²-s. The threshold is applied in this OEIS/EIS as an “all-or-nothing” value, where 100% of animals receiving SEL ≥ 195 dB re 1 μPa²-s are considered to experience TTS. From the standpoint of statistical sampling and prediction theory, the mean is the most appropriate predictor – the “best unbiased estimator” – of the SEL at which onset-TTS should occur; predicting the number of harassment incidents in future actions relies (in part) on using the SEL at which onset-TTS will most likely occur. When the SEL is applied over many pings in each of many sonar exercises, that value will provide the most accurate prediction of the actual number of harassment incidents by onset-TTS over all of those exercises. Use of the minimum
value would overestimate the amount of incidental harassment because many animals counted would not have experienced onset-TTS. Further, there is no logical limiting minimum value of the distribution that would be obtained from continued successive testing. Continued testing and use of the minimum would produce more and more erroneous estimates for the “all-or-nothing” threshold for effect.

**4.3.3.1 Criteria and Thresholds for MMPA Harassment – Risk Function**

**4.3.3.1.1 Background**

Based on available evidence, marine animals are likely to exhibit any of a suite of potential behavioral responses or combinations of behavioral responses upon exposure to sonar transmissions. Potential behavioral responses include, but are not limited to: avoiding exposure or continued exposure; behavioral disturbance (including distress or disruption of social or foraging activity); habituation to the sound; becoming sensitized to the sound; or not responding to the sound.

Existing studies of behavioral effects of human-made sounds in marine environments remain inconclusive, partly because many of those studies have lacked adequate controls, applied only to certain kinds of exposures (which are often different from the exposures being analyzed in the study), and had limited ability to detect behavioral changes that may be significant to the biology of the animals that were being observed. These studies are further complicated by the wide variety of behavioral responses marine mammals exhibit and the fact that those responses can vary substantially by species, individuals, and the context of an exposure. In some circumstances, some individuals will continue normal behavioral activities in the presence of high levels of human-made noise. In other circumstances, the same individual or other individuals may avoid an acoustic source at much lower received levels (Richardson et al., 1995; Wartzok et al., 2003; Southall et al., 2007). These differences within and between individuals appear to result from a complex interaction of experience, motivation, and learning that are difficult to quantify and predict.

It is possible that some marine mammal behavioral reactions to anthropogenic sound may result in strandings. Several “mass stranding” events—strandings that involve two or more individuals of the same species (excluding a single cow–calf pair)—that have occurred over the past two decades have been associated with naval operations, seismic surveys, and other anthropogenic activities that introduced sound into the marine environment. Sonar exposure has been identified as a contributing cause or factor in five specific mass stranding events: Greece in 1996; the Bahamas in March 2000; Madeira, Portugal in 2000; the Canary Islands in 2002, and Spain in 2006 (Advisory Committee Report on Acoustic Impacts on Marine Mammals, 2006).

In these circumstances, exposure to acoustic energy has been considered a potential indirect cause of the death of marine mammals (Cox et al., 2006). A popular hypothesis regarding a potential cause of the strandings is that tissue damage results from a “gas and fat embolic syndrome” (Fernandez et al., 2005; Jepson et al., 2003; 2005). Models of nitrogen saturation in
diving marine mammals have been used to suggest that altered dive behavior might result in the accumulation of nitrogen gas such that the potential for nitrogen bubble formation is increased (Houser et al., 2001b; Zimmer and Tyack, 2007). If so, this mechanism might explain the findings of gas and bubble emboli in stranded beaked whales. It is also possible that stranding is a behavioral response to a sound under certain contextual conditions and that the subsequently observed physiological effects of the strandings (e.g., overheating, decomposition, or internal hemorrhaging from being on shore) were the result of the stranding and not the direct result of exposure to sonar (Cox et al., 2006).

4.3.3.1.2 Risk Function Adapted from Feller (1968)

The particular acoustic risk function developed by the Navy and NMFS estimates the probability of behavioral responses that the NMFS would classify as harassment for the purposes of the MMPA given exposure to specific received levels of MFA sonar. The mathematical function is derived from a solution in Feller (1968) for the probability as defined in the SURTASS LFA Sonar Final OEIS/EIS (DoN, 2001b), and relied on in the Supplemental SURTASS LFA Sonar EIS (DoN, 2007k) for the probability of MFA sonar risk for MMPA Level B behavioral harassment with input parameters modified by the NMFS for MFA sonar for mysticetes, odontocetes, and pinnipeds.

In order to represent a probability of risk, the function should have a value near zero at very low exposures, and a value near one for very high exposures. One class of functions that satisfies this criterion is cumulative probability distributions, a type of cumulative distribution function. In selecting a particular functional expression for risk, several criteria were identified:

- The function must use parameters to focus discussion on areas of uncertainty;
- The function should contain a limited number of parameters;
- The function should be capable of accurately fitting experimental data; and
- The function should be reasonably convenient for algebraic manipulations.

As described in DoN (2001c), the mathematical function below is adapted from a solution in Feller (1968).

\[
R = \frac{1 - \left( \frac{L - B}{K} \right)^{-A}}{1 - \left( \frac{L - B}{K} \right)^{-2.4}}
\]

Where:  
\( R = \text{risk} \ (0 - 1.0) \);  
\( L = \text{received Level (RL) in dB} \);
B = basement RL in dB; (120 dB);
K = the RL increment above basement in dB at which there is 50 percent risk;
A = risk transition sharpness parameter (A=10 odontocetes (except harbor porpoises)/pinnipeds; A=8 mysticetes) (explained in Section 4.3.3.1.5).

In order to use this function, the values of the three parameters (B, K, and A) need to be established. As further explained in Section 4.3.3.1.3, the values used in this analysis are based on three sources of data: TTS experiments conducted at SSC and documented in Finneran, et al. (2001, 2003, and 2005); Finneran and Schlundt, (2004); reconstruction of sound fields produced by the U.S.S. Shoup associated with the behavioral responses of killer whales observed in Haro Strait and documented in Department of Commerce NMFS, (2005a); DoN (2004e); and Fromm (2004a, b); and observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components documented in Nowacek et al. (2004). The input parameters, as defined by the NMFS, are based on very limited data that represent the best available science at this time.

4.3.3.1.3 Data Sources Used for Risk Function

There is widespread consensus that cetacean response to MFA sound signals needs to be better defined using controlled experiments (Cox et al., 2006; Southall et al., 2007). The Navy is contributing to an ongoing behavioral response study in the Bahamas that is anticipated to provide some initial information on beaked whales, the species identified as the most sensitive to MFA sonar. The NMFS is leading this international effort with scientists from various academic institutions and research organizations to conduct studies on how marine mammals respond to underwater sound exposures.

Until additional data is available, the NMFS and Navy have determined that the following three data sets are most applicable for the direct use in developing risk function parameters for MFA sonar. These data sets represent the only known data that specifically relate altered behavioral responses to exposure to MFA sound sources. Until applicable data sets are evaluated to better qualify harassment from HFA sources, the risk function derived for MFA sources will apply to HFA.

Data from SSC’s Controlled Experiments

Most of the observations of the behavioral responses of toothed whales resulted from a series of controlled experiments on bottlenose dolphins and beluga whales conducted by researchers at SSC’s facility in San Diego, California (Finneran et al., 2001, 2003, 2005; Finneran and Schlundt 2004; Schlundt et al., 2000). In experimental trials with marine mammals trained to perform tasks when prompted, scientists evaluated whether the marine mammals performed these tasks when exposed to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests (Schlundt et al., 2000, Finneran et al.,
Bottlenose dolphins exposed to 1-second (sec) intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 μPa root mean square (rms), and beluga whales did so at received levels of 180 to 196 dB and above. Test animals sometimes vocalized after an exposure to impulsive sound from a seismic watergun (Finneran et al., 2002). In some instances, animals exhibited aggressive behavior toward the test apparatus (DoN., 1997b; Schlundt et al., 2000).

1. Finneran and Schlundt (2004) examined behavioral observations recorded by the trainers or test coordinators during the Schlundt et al. (2000) and Finneran et al. (2001, 2003, 2005) experiments featuring 1-sec tones. These included observations from 193 exposure sessions (fatiguing stimulus level > 141 dB re 1μPa) conducted by Schlundt et al. (2000) and 21 exposure sessions conducted by Finneran et al. (2001, 2003, 2005). The observations were made during exposures to sound sources at 0.4 kHz, 3 kHz, 10 kHz, 20 kHz, and 75 kHz. The TTS experiments that supported Finneran and Schlundt (2004) are further explained below:

a. Schlundt et al. (2000) provided a detailed summary of the behavioral responses of trained marine mammals during TTS tests conducted at SSC San Diego with 1-sec tones. Schlundt et al. (2000) reported eight individual TTS experiments. Fatiguing stimuli durations were 1-sec; exposure frequencies were 0.4 kHz, 3 kHz, 10 kHz, 20 kHz and 75 kHz. The experiments were conducted in San Diego Bay. Because of the variable ambient noise in the bay, low-level broadband masking noise was used to keep hearing thresholds consistent despite fluctuations in the ambient noise. Schlundt et al. (2000) reported that “behavioral alterations,” or deviations from the behaviors the animals being tested had been trained to exhibit, occurred as the animals were exposed to increasing fatiguing stimulus levels.

b. Finneran et al. (2001, 2003, 2005) conducted TTS experiments using tones at 3 kHz. The test method was similar to that of Schlundt et al. (2000) except the tests were conducted in a pool with very low ambient noise level (below 50 dB re 1 μPa2/hertz [Hz]), and no masking noise was used. Two separate experiments were conducted using 1-sec tones. In the first, fatiguing sound levels were increased from 160 to 201 dB SPL. In the second experiment, fatiguing sound levels between 180 and 200 dB SPL were randomly presented.

Data from Studies of Baleen (Mysticetes) Whale Responses

The only mysticete data available resulted from a field experiments in which baleen whales (mysticetes) were exposed to sounds ranging in frequency from 50 Hz (ship noise playback) to 4500 Hz (alert stimulus) (Nowacek et al., 2004). Behavioral reactions to an alert stimulus,
consisting of a combination of tones and frequency and amplitude modulated signals ranging in frequency from 500 Hz to 4500 Hz, was the only portion of the study used to support the risk function input parameters.

2. Nowacek et al. (2004; 2007) documented observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components. To assess risk factors involved in ship strikes, a multi-sensor acoustic tag was used to measure the responses of whales to passing ships and experimentally tested their responses to controlled sound exposures, which included recordings of ship noise, the social sounds of conspecifics and a signal designed to alert the whales. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. The purposes of the alert signal were (a) to provoke an action from the whales via the auditory system with disharmonic signals that cover the whales’ estimated hearing range; (b) to maximize the signal to noise ratio (obtain the largest difference between background noise) and c) to provide localization cues for the whale. Five out of six whales reacted to the signal designed to elicit such behavior. Maximum received levels ranged from 133 to 148 dB re 1μPa.

Observations of Killer Whales in Haro Strait in the Wild

In May 2003, killer whales (Orcinus orca) were observed exhibiting behavioral responses while U.S.S. Shoup was engaged in MFA sonar operations in the Haro Strait in the vicinity of Puget Sound, Washington. Although these observations were made in an uncontrolled environment, the sound field associated with the sonar operations had to be estimated, and the behavioral observations were reported for groups of whales, not individual whales, the observations associated with the U.S.S. Shoup provide the only data set available of the behavioral responses of wild, non-captive animal upon exposure to the AN/SQS-53 MFA sonar.

3. U.S. Department of Commerce (NMFS, 2005a); DoN (2004e); Fromm (2004a,b) documented reconstruction of sound fields produced by U.S.S. Shoup associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an estimate of 169.3 dB SPL which represents the mean received level at a point of closest approach within a 500 m wide area in which the animals were exposed. Within that area, the estimated received levels varied from approximately 150 to 180 dB SPL.
4.3.3.1.4 Limitations of the Risk Function Data Sources

There are substantial limitations and challenges to any risk function derived to estimate the probability of marine mammal behavioral responses; these are largely attributable to sparse data. Ultimately there should be multiple functions for different marine mammal taxonomic groups, but the current data are insufficient to support them. The goal is unquestionably that risk functions be based on empirical measurement.

The risk function presented here is based on three data sets that the NMFS and Navy have determined are the best available science at this time. The Navy and NMFS acknowledge each of these data sets has limitations.

While the NMFS considers all data sets as being weighted equally in the development of the risk function, the Navy believes the SSC San Diego data is the most rigorous and applicable for the following reasons:

- The data represents the only source of information where the researchers had complete control over and ability to quantify the noise exposure conditions.
- The altered behaviors were identifiable due to long-term observations of the animals.
- The fatiguing noise consisted of tonal exposures with limited frequencies contained in the MFA sonar bandwidth.

However, the Navy and NMFS do agree that the following are limitations associated with the three data sets used as the basis of the risk function:

- The three data sets represent the responses of only four species: trained bottlenose dolphins and beluga whales, North Atlantic right whales in the wild, and killer whales in the wild.
- None of the three data sets represent experiments designed for behavioral observations of animals exposed to MFA sonar.
- The behavioral responses of marine mammals that were observed in the wild are based solely on an estimated received level of sound exposure; they do not take into consideration (due to minimal or no supporting data):
  - Potential relationships between acoustic exposures and specific behavioral activities (e.g., feeding, reproduction, changes in diving behavior, etc.), variables such as bathymetry, or acoustic waveguides; or
Differences in individuals, populations, or species, or the prior experiences, reproductive state, hearing sensitivity, or age of the marine mammal.

**SSC San Diego Trained Bottlenose Dolphins and Beluga Data Set:**

- The animals were trained animals in captivity; therefore, they may be more or less sensitive than cetaceans found in the wild (Domjan, 1998).
- The tests were designed to measure TTS, not behavior.
- Because the tests were designed to measure TTS, the animals were exposed to much higher levels of sound than the baseline risk function (only two of the total 193 observations were at levels below 160 dB re 1 \mu Pa2-s).
- The animals were not exposed in the open ocean but in a shallow bay or pool.
- The tones used in the tests were 1-second pure tones similar to MFA sonar.

**North Atlantic Right Whales in the Wild Data Set:**

- The observations of behavioral response were from exposure to alert stimuli that contained mid-frequency components but were not similar to an MFA sonar ping. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. This 18-minute alert stimulus is in contrast to the average 1-sec ping every 30 sec in a comparatively very narrow frequency band used by military sonar.
- The purpose of the alert signal was, in part, to provoke an action from the whales through an auditory stimulus.

**Killer Whales in the Wild Data Set:**

- The observations of behavioral harassment were complicated by the fact that there were other sources of harassment in the vicinity (other vessels and their interaction with the animals during the observation).
The observations were anecdotal and inconsistent. There were no controls during the observation period, with no way to assess the relative magnitude of the observed response as opposed to baseline conditions.

4.3.3.1.5 Input Parameters for the Feller-Adapted Risk Function

The values of B, K, and A need to be specified in order to utilize the risk function defined in Section 4.3.3.1.2 previously. The risk continuum function approximates the dose-response function in a manner analogous to pharmacological risk assessment (DoN, 2001b, Appendix A). In this case, the risk function is combined with the distribution of sound exposure levels to estimate aggregate impact on an exposed population.

**Basement Value for Risk—The B Parameter**

The B parameter defines the basement value for risk, below which the risk is so low that calculations are impractical. This 120 dB level is taken as the estimate received level (RL) below which the risk of significant change in a biologically important behavior approaches zero for the MFA sonar risk assessment. This level is based on a broad overview of the levels at which multiple species have been reported responding to a variety of sound sources, both mid-frequency and other, was recommended by the scientists, and has been used in other publications. The Navy recognizes that for actual risk of changes in behavior to be zero, the signal-to-noise ratio of the animal must also be zero.

**The K Parameter**

The NMFS and Navy used the mean of the following values to define the midpoint of the function: (1) the mean of the lowest received levels (185.3 dB) at which individuals responded with altered behavior to 3 kHz tones in the SSC data set; (2) the estimated mean received level value of 169.3 dB produced by the reconstruction of the U.S.S. Shoup incident in which killer whales exposed to MFA sonar (range modeled possible received levels: 150 to 180 dB); and (3) the mean of the 5 maximum received levels at which Nowacek et al. (2004) observed significantly altered responses of right whales to the alert stimuli than to the control (no input signal) is 139.2 dB SPL. The arithmetic mean of these three mean values is 165 dB SPL. The value of K is the difference between the value of B (120 dB SPL) and the 50 percent value of 165 dB SPL; therefore, K=45.

**Risk Transition—The A Parameter**

The A parameter controls how rapidly risk transitions from low to high values with increasing receive level. As A increases, the slope of the risk function increases. For very large values of A, the risk function can approximate a threshold response or step function. The NMFS has recommended that the Navy use A=10 as the value for odontocetes (except harbor porpoises), and pinnipeds, and A=8 for mysticetes, (Figures 4.3-4 and 4.3-5) (NMFS, 2008e).
Justification for the Steepness Parameter of $A=10$ for the Odontocete Curve

The NMFS independent review process described in Section 4.1.2.4.9 of the Hawaii Range Complex Final EIS/OEIS (DoN, 2008a) provided the impetus for the selection of the parameters for the risk function curves. One scientist recommended staying close to the risk continuum concept as used in the SURTASS LFA sonar EIS. This scientist opined that both the basement and slope values; $B=120$ dB and $A=10$ respectively, from the SURTASS LFA sonar risk continuum concept are logical solutions in the absence of compelling data to select alternate values supporting the Feller-adapted risk function for MFA sonar. Another scientist indicated a steepness parameter needed to be selected, but did not recommend a value. Four scientists did not specifically address selection of a slope value. After reviewing the six scientists’ recommendations, the two NMFS scientists recommended selection of $A=10$. Direction was provided by the NMFS to use the $A=10$ curve for odontocetes based on the scientific review of potential risk functions explained in Section 4.1.2.4.9.2 of DoN, 2008a.

![Risk Function Curve for Odontocetes (Toothed Whales, excluding harbor porpoises) and Pinnipeds](image)

**Figure 4.3-4**

Risk Function Curve for Odontocetes (Toothed Whales, excluding harbor porpoises) and Pinnipeds
As background, a sensitivity analysis of the $A=10$ parameter was undertaken and presented in Appendix D of the SURTASS/LFA FEIS (DoN, 2001b). The analysis was performed to support the $A=10$ parameter for mysticete whales responding to a low-frequency sound source, a frequency range to which the mysticete whales are believed to be most sensitive to. The sensitivity analysis results confirmed the increased risk estimate for animals exposed to sound levels below 165 dB. Results from the Low Frequency Sound Scientific Research Program (LFS SRP) phase II research showed that whales (specifically gray whales in their case) did scale their responses with received level as supported by the $A=10$ parameter (Buck and Tyack, 2000). In the second phase of the LFS SRP research, migrating gray whales showed responses similar to those observed in earlier research (Malme et al., 1983, 1984) when the LF source was moored in the migration corridor (2 km [1.1 nm] from shore). The study extended those results with confirmation that a louder SL elicited a larger scale avoidance response. However, when the source was placed offshore (4 km [2.2 nm] from shore) of the migration corridor, the avoidance response was not evident. This implies that the inshore avoidance model – in which 50 percent of the whales avoid exposure to levels of $141 + 3$ dB – may not be valid for whales in proximity to an offshore source (DoN, 2001b). As concluded in the SURTASS LFA Sonar Final OEIS/EIS (DoN, 2001b), the value of $A=10$ produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme et al., 1984; Buck and Tyack, 2000; SURTASS LFA Sonar EIS [DoN, 2001b], Subchapters 1.43, 4.2.4.3, and Appendix D; and NMFS, 2008e).
**Justification for the steepness parameter of A=8 for the Mysticete Curve**

The Nowacek et al. (2004) study provides the only available data source for a mysticete species behaviorally responding to a sound source (i.e., alert stimuli) with frequencies in the range of tactical mid-frequency sonar (1-10 kHz), including empirical measurements of received levels (RLs). While there are fundamental differences in the stimulus used by Nowacek et al. (2004) and tactical mid-frequency sonar (e.g., source level, waveform, duration, directionality, likely range from source to receiver), they are generally similar in frequency band and the presence of modulation patterns. Thus, while they must be considered with caution in interpreting behavioral responses of mysticetes to mid-frequency sonar, they seemingly cannot be excluded from this consideration given the overwhelming lack of other information. The Nowacek et al. (2004) data indicate that five out the six North Atlantic right whales exposed to an alert stimuli “significantly altered their regular behavior and did so in identical fashion” (i.e., ceasing feeding and swimming to just under the surface). For these five whales, maximum RLs associated with this response ranged from root-mean-square sound (rms) pressure levels of 133-148 dB (re: 1 μPa).

When six scientists (one of them being Nowacek) were asked to independently evaluate available data for constructing a dose response curve based on a solution adapted from Feller (1968), the majority of them (4 out of 6; one being Nowacek) indicated that the Nowacek et al. (2004) data were not only appropriate but also necessary to consider in the analysis. While other parameters associated with the solution adapted from Feller (1968) were provided by many of the scientists (i.e., basement parameter [B], increment above basement where there is 50% risk [K]), only one scientist provided a suggestion for the risk transition parameter, A.

A single curve may provide the simplest quantitative solution to estimating behavioral harassment. However, the policy decision, by the NMFS-OPR, to adjust the risk transition parameter from A=10 to A=8 for mysticetes and create a separate curve was based on the fact the use of this shallower slope better reflected the increased risk of behavioral response at relatively low RLs suggested by the Nowacek et al. (2004) data. In other words, by reducing the risk transition parameter from 10 to 8, the slope of the curve for mysticetes is reduced. This results in an increase the proportion of the population being classified as behaviorally harassed at lower RLs. It also slightly reduces the estimate of behavioral response probability at quite high RLs, though this is expected to have quite little practical result owing to the very limited probability of exposures well above the mid-point of the function. This adjustment allows for a slightly more conservative approach in estimating behavioral harassment at relatively low RLs for mysticetes compared to the odontocete curve and is supported by the only dataset currently available. It should be noted that the current approach (with A=8) still yields an extremely low probability for behavioral responses at RLs between 133-148 dB, where the Nowacek data indicated significant responses in a majority of whales studied. (Note: Creating an entire curve based strictly on the Nowacek et al. [2004] data alone for mysticetes was advocated by several of the reviewers and considered inappropriate, by the NMFS-OPR, since the sound source used in this study was not identical to tactical mid-frequency sonar, and there were only 5 data points available). The policy adjustment made by the NMFS-OPR was also intended to capture some of the additional recommendations and considerations provided by the scientific panel (i.e., the curve should be...
more data driven and that a greater probability of risk at lower RLs be associated with direct application of the Nowacek et al. 2004 data).

4.3.3.1.6 Basic Application of the Risk Function and Relation to the Current Regulatory Scheme

The risk function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy’s testing and training with MFA sonar) at a given received level of sound. As an example, Figure 4.3-6 illustrates this relationship for a representative marine animal. Between 160 and 170 dB SPL (dB re: 1μPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent, and the Navy/NMFS applies that by estimating that 50 percent of the individuals exposed at that received level are likely to respond by exhibiting behavior that the NMFS would classify as behavioral harassment. The risk function is not applied to individual animals, only to exposed populations.

If graphically depicted, percent harassment by received decibel level for the same mid-frequency active sonar as that from Table 4.3-1 would follow the curve shown in Figure 4.3-6. As can be seen also in Table 4.3-1, Figure 4.3-6 illustrates that the bulk of harassments are centered on the 160 to 170 dB level.

Table 4.3-1

<table>
<thead>
<tr>
<th>Received Level</th>
<th>Distance at Which Levels Occur Within Jacksonville Study Area</th>
<th>Percent of Harassments Occurring at Given Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>120&gt;=SPL&lt;130</td>
<td>147 km - 107 km</td>
<td>0%</td>
</tr>
<tr>
<td>130&gt;=SPL&lt;140</td>
<td>107 km - 71 km</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>140&gt;=SPL&lt;150</td>
<td>71 km - 43.8 km</td>
<td>4%</td>
</tr>
<tr>
<td>150&gt;= SPL &lt;160</td>
<td>43.8 km - 20 km</td>
<td>34%</td>
</tr>
<tr>
<td>160&gt;= SPL &lt;170</td>
<td>20 km - 6.2 km</td>
<td>50%</td>
</tr>
<tr>
<td>170&gt;= SPL &lt;180</td>
<td>6.2 km - 1.1 km</td>
<td>11%</td>
</tr>
<tr>
<td>180&gt;= SPL &lt;190</td>
<td>1.1 km - 0.2 km</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>190&gt;= SPL &lt;195</td>
<td>214 m - 103 m</td>
<td>0%</td>
</tr>
<tr>
<td>PTS (215 dB SEL)</td>
<td>10 m</td>
<td>0%</td>
</tr>
</tbody>
</table>
The data used to produce the risk function were compiled from four species that had been exposed to sound sources in a variety of different circumstances. As a result, the risk function represents a general relationship between acoustic exposures and behavioral responses that is then applied to specific circumstances. That is, the risk function represents a relationship that is deemed to be generally true, based on the limited, best-available science, but may not be true in specific circumstances. In particular, the risk function, as currently derived, treats the received level as the only variable that is relevant to a marine mammal’s behavioral response. However, we know that many other variables—the marine mammal’s gender, age, and prior experience; the activity it is engaged in during an exposure event, its distance from a sound source, the number of sound sources, and whether the sound sources are approaching or moving away from the animal—can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall et al., 2007). The data that are currently available do not allow for incorporation of these other variables in the current risk functions; however, the risk function represents the best use of the data that are available.
The NMFS and Navy made the decision to apply the MFA risk function curve to HFA sources due to lack of available and complete information regarding HFA sources. As more specific and applicable data become available for MFA/HFA sources, the NMFS can use these data to modify the outputs generated by the risk function to make them more realistic. Ultimately, data may exist to justify the use of additional, alternate, or multi-variate functions. As mentioned above, it is known that the distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al., 2003). In the Hawaii Range Complex (HRC) example, animals exposed to received levels between 120 and 130 dB may be more than 65 nautical miles (131,651 yards) from a sound source; those distances would influence whether those animals might perceive the sound source as a potential threat, and their behavioral responses to that threat. Though there are data showing marine mammal responses to sound sources at that received level, the NMFS does not currently have any data that describe the response of marine mammals to sounds at that distance (or to other contextual aspects of the exposure, such as the presence of higher frequency harmonics), much less data that compare responses to similar sound levels at varying distances. However, if data were to become available that suggested animals were less likely to respond (in a manner the NMFS would classify as harassment) to certain levels beyond certain distances, or that they were more likely to respond at certain closer distances, the Navy will re-evaluate the risk function to try to incorporate any additional variables into the “take” estimates.

Last, pursuant to the MMPA, an applicant is required to estimate the number of animals that will be “taken” by their activities. This estimate informs the analysis that the NMFS must perform to determine whether the activity will have a “negligible impact” on the species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences, though there are known avenues through which behavioral disturbance of individuals can result in population-level effects. Alternately, a negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be “taken” through harassment, the NMFS must consider other factors, such as the nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat. Generally speaking, the Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels.

4.3.3.1.7 Specific Consideration for Harbor Porpoises

The information currently available regarding these inshore species that inhabit shallow and coastal waters suggests a very low threshold level of response for both captive and wild animals. Threshold levels at which both captive (e.g. Kastelein et al., 2000, 2005b, 2006a) and wild
harbor porpoises (e.g. Johnston, 2002) responded to sound (e.g. acoustic harassment devices (ADHs), acoustic deterrent devices (ADDs), or other non-pulsed sound sources) is very low (e.g. ~120 dB SPL), although the biological significance of the disturbance is uncertain. Therefore, Navy will not use the risk function curve as presented but will apply a step function threshold of 120 dB SPL estimate take of harbor porpoises (i.e., assumes that all harbor porpoises exposed to 120 dB or higher MFAS/HFAS will respond in a way the NMFS considers behavioral harassment).

4.3.3.1.8 Navy Post Acoustic Modeling Analysis

The quantification of the acoustic modeling results includes additional analysis to increase the accuracy of the number of marine mammals affected. Table 4.3-2 provides a summary of the modeling protocols used in this analysis. Post modeling analysis includes:

- Reducing acoustic footprints where they encounter land masses.
- Accounting for acoustic footprints for sonar sources that overlap to accurately sum the total area when multiple ships are operating together, and to better account for the maximum number of individuals of a species that could potentially be exposed to sonar within the course of one day or a discreet continuous sonar event.
### Table 4.3-2

<table>
<thead>
<tr>
<th>Navy Protocols Providing for Accurate Modeling Quantification of Marine Mammal Exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Historical Data</strong></td>
</tr>
<tr>
<td><strong>Acoustic Parameters</strong></td>
</tr>
<tr>
<td><strong>Submarine Sonar</strong></td>
</tr>
<tr>
<td><strong>Land Shadow</strong></td>
</tr>
<tr>
<td><strong>Multiple Ships</strong></td>
</tr>
<tr>
<td><strong>Multiple Exposures</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
4.3.4 Potential for Prolonged Exposure and Long-Term Effects

4.3.4.1 Likelihood of Prolonged Exposure

One concern for the proposed operations at the USWTR is the possibility that an animal (or group of animals) may experience long-term effects because of repeated, prolonged exposures to high-level sonar signals. As discussed below, this is unlikely because the sonars have limited effect ranges and relatively high platform speeds.

The list of sonar actions for the proposed USWTR is complicated. The focus here is on the sonars with the most potential for effect. More detail may be found in the Naval Undersea Warfare Center (NUWC) Marine Mammals Effect Model (MMEM) report (NUWC, 2005). Planned use of the USWTR may be described as follows:

- Range use is planned for 480 training events per year.
- Each event would last from one to six hours.
- Surface ship sonar operations would occur in 100 events. (Scenario 2: 62 events that involve one ship; Scenario 4: 38 events that typically involve two ships – This scenario includes periods when one ship uses active sonar and periods when both ships use active sonar simultaneously.)
- Of the events incorporating surface ship sonar, use of the SQS-53 is planned for 70% of the events and the SQS-56 is used for the remaining 30% of the events.
- The total operational time for each event involving the SQS-53 would be split 50% for the surface ship sonar and 50% for either dipping sonar or sonobuoys (Scenario 2: 62 events x 3.5 hours x 50% = 108.5 hours; The calculation is similar for Scenario 4 except for the potential of simultaneous active sonar use. This is equivalent to active sonar use for 67% of an event – Scenario 4: 38 events x 3.5 hours x 67% = 89.1 hours; total operational time for Scenarios 2 and 4 = 197.6 hours).
- When the SQS-53 is in search mode, which has the greatest potential for acoustic effects, the sonar is used 67% of the operational time (197.6 hours x 67% search mode = 132.4 hours). The remaining time the sonar is in target mode, which has lower acoustic effects.
- The SQS-53 would be operational in search mode, the mode with the greatest potential for acoustic effect, 7.9% of the yearly training time (132.4 hours/[1,700 hours] x 100% = 7.9%).
ASW activities would not result in prolonged exposure because the constant movement of the vessels, the platform speed, the time delay between pings, and the flow of the activity when training occurs all reduce the potential for prolonged exposure. The implementation of the protective measures described in Section 6 would further reduce the likelihood of any prolonged exposure.

4.3.4.2 Long-Term Effects

The proposed USWTR would repeatedly use the same area of ocean over a period of years, so there could be effects to marine mammals that may occur as a result of repeated use over time that may become evident over longer periods of time (e.g., changes in habitat use or habituation). However, as described in Subchapters 4.3.3.1 and 4.3.4, this OEIS/EIS assumes that short-term non-injurious sound levels predicted to cause TTS or temporary behavioral disruptions qualify as Level B harassment. Application of this criterion assumes an effect even though it is highly unlikely that all behavioral disruptions or instances of TTS will result in long-term impacts. The Navy considers this overestimate of Level B harassment to be prudent due to the proposed repetitive use of a USWTR off the east coast of the U.S.. This approach is conservative because:

- There is no established scientific correlation between MFA sonar use and long-term abandonment or significant alteration of behavioral patterns in marine mammals.
- It is unlikely that a marine mammal (or group of animals) would experience any long-term effects because the proposed training use of the instrumented range makes individual mammals’ repeated and/or prolonged exposures to high-level sonar signals unlikely.
- In addition to the conservative approach for estimating Level B harassment, as an additional measure, a monitoring program will be implemented to study the potential long-term effects of repeated short-term sound exposures over time. Significant long-term changes in habitat use or behavior, if they occur, might only become evident over an extended monitoring period. Further information on the program to be implemented to monitor for these potential changes is provided in Chapter 6.

4.3.5 Acoustic Sources

Potential acoustic sources for the USWTR were examined with regard to their operational characteristics. Based on this analysis, nine acoustic sources were selected for marine mammal
acoustic effect analysis. The other acoustic sources used during training were determined, due to their operational characteristics, to have a negligible potential to affect marine mammals and, therefore, did not require further examination.

It is important to note that, as a group, marine mammals have functional hearing ranging from 10 hertz (Hz) to 200 kHz; however, their best hearing sensitivities are well below that level. Since active sonar sources operating at 200 kHz or higher attenuate rapidly and are at or outside the upper frequency limit of even the ultrasonic species of marine mammals, further consideration and modeling of these higher frequency acoustic sources are not warranted. As such, high-frequency active sonar systems in excess of 200 kHz are not analyzed in this EIS/OEIS.

Table 4.3-3 provides a list of active acoustic sources that were determined to be non-problematic. Non-problematic acoustic sources would have a negligible potential to affect marine mammals for the reasons discussed in the foregoing paragraph. Each source is described and not further addressed from an acoustic effect standpoint. Some of the operating characteristics of these sources are classified and, therefore, are described in general terms.

<table>
<thead>
<tr>
<th>Acoustic Source</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underwater mobile sound communications (UQC) (surface ships, submarines, sensor nodes)</td>
<td>Source levels 188 – 193 dB re 1 μPa between 8 – 11 kHz.</td>
</tr>
<tr>
<td>Fathometer</td>
<td>Source frequency: 12 kHz. System is not unique to military and operates identically to any commercially available bottom sounder.</td>
</tr>
<tr>
<td>Mk 30 Target</td>
<td>Source level is not problematic but is classified.</td>
</tr>
<tr>
<td>Mk 39 EMATT</td>
<td>Source level is not problematic but is classified.</td>
</tr>
<tr>
<td>Pinger</td>
<td>Operational equipment used primarily for submarine safety</td>
</tr>
</tbody>
</table>
Table 4.3-4 details the acoustic sources modeled in this analysis:

Table 4.3-4

<table>
<thead>
<tr>
<th>Acoustic Source</th>
<th>Frequency</th>
<th>Source Level (re 1µPa)</th>
<th>Platform Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN/SQS-53</td>
<td>3.5 kHz</td>
<td>235 dB</td>
<td>DDG and CG hull-mounted sonar</td>
<td>ASW search, detection, and localization; utilized 70% in search mode and 30% track mode</td>
</tr>
<tr>
<td>AN/AQS-22 (Airborne, Low Frequency Sonar [ALFS])</td>
<td>4.1 kHz</td>
<td>217 dB</td>
<td>Helicopter dipping sonar</td>
<td>ASW sonar lowered from hovering helicopter (approximately 10 pings/dip, 30 seconds between pings)</td>
</tr>
<tr>
<td>AN/SQS-56</td>
<td>7.5 kHz</td>
<td>225 dB</td>
<td>FFG hull-mounted sonar</td>
<td>ASW search, detection, localization; utilized 70% in search mode and 30% track mode</td>
</tr>
<tr>
<td>MK-48 Torpedo</td>
<td>HF</td>
<td>Classified</td>
<td>Submarine fired exercise torpedo</td>
<td>Recoverable and non-explosive exercise torpedo; sonar is active approximately 15 min per torpedo run</td>
</tr>
<tr>
<td>MK-46/MK-54 Torpedo</td>
<td>HF</td>
<td>Classified</td>
<td>Surface ship and aircraft fired exercise torpedo</td>
<td>Recoverable and non-explosive exercise torpedo; sonar is active approximately 15 min per torpedo run</td>
</tr>
<tr>
<td>AN/SLQ-25 (NIXIE)</td>
<td>MF</td>
<td>Classified</td>
<td>DDG, CG, and FFG towed array</td>
<td>Towed countermeasure to avert localization and torpedo attacks (approximately 20 min per use)</td>
</tr>
<tr>
<td>Tonal sonobuoy (DICASS) (AN/SSQ-62)</td>
<td>8 kHz</td>
<td>201 dB</td>
<td>Helicopter and MPA deployed</td>
<td>Remotely commanded expendable sonar-equipped buoy (approximately 12 pings, 30 s between pings)</td>
</tr>
<tr>
<td>Submarine deployed countermeasures</td>
<td>MF</td>
<td>Classified</td>
<td>Submarine deployed countermeasure</td>
<td>Expendable acoustic countermeasure (approximately 20 min per use)</td>
</tr>
</tbody>
</table>

Helicopters also use the AN/AQS-13 [10.0 kHz; 215db], but all helicopters were modeled using the AN/AQS-22, which has a somewhat higher source level. The AN/SQS-22 ALFS was used as the worst-case source for the dipping sonar, thus preempting the need to model the AN/AQS-13 dipping sonar. These five acoustic sources would be employed in various combinations in each exercise scenario.

In addition to identifying the sonars modeled and used in each scenario, details of the operational duty cycles for the training platforms and active systems are needed to permit calculation of the
total operating time of each source. Table 4.3-5 (and the bulleted items that follow) contains summary information pertaining to the operation duty cycles.

Table 4.3-5

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Participants</th>
<th>Acoustic Sources</th>
<th>Operational Duty Cycles Applied</th>
<th>Estimated USWTR Training Events/Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P3 or helicopter vs. submarine</td>
<td>ALFS; DICASS; pinger; fathometer; MK46, acoustic countermeasures</td>
<td>50% ALFS/50% DICASS</td>
<td>355</td>
</tr>
<tr>
<td>2</td>
<td>One helicopter and one surface ship vs. submarine</td>
<td>ALFS; DICASS; SQS-53; SQS-56; MK 48; MK46; pinger; fathometer; acoustic countermeasures</td>
<td>50% ALFS/50% DICASS; 50% helicopter/50% surface ship; 67% search/33% target</td>
<td>62</td>
</tr>
<tr>
<td>3</td>
<td>Submarine vs. submarine</td>
<td>BQQ-5/10; MK 48; pinger; fathometer; acoustic countermeasures</td>
<td>1 ping/hour</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Two surface ships and two helicopters vs. submarine</td>
<td>SQS-53; SQS-56; ALFS; DICASS; MK 48; MK46; pinger; fathometer; acoustic countermeasure</td>
<td>50% ALFS/50% DICASS; 50% helicopter/50% surface ship; 67% search/33% target; 67% for each ship/helicopter team</td>
<td>38</td>
</tr>
</tbody>
</table>

- **Helicopter Operation** – The helicopter prosecutes the target using active sonobuoys and dipping sonar each 50% of the time. The helicopter splits its active transmission time 50% with surface ships.

- **Surface Ship Operation** – The surface ship and helicopter split active searching for the target 50% of the time each. The distribution between AN/SQS-53 sonar and AN/SQS-56 sonar is 70% and 30%, respectively, for the Fleet. The surface ship sonar operates 67% in a search mode and 33% in a track mode. The nominal source level for USWTR training scenarios would be 235 and 225 dB re 1μPa² s @ 1 m for the SQS-53 and SQS-56, respectively (assuming 1-second ping at 235 SPL).

- **Dipping Sonar** – Each dipping sonar transmission consists of ten pings at the dip point with 3,000 m (9,840 ft) and 15 minutes between dips.
• **Mk 48 Torpedoes** – An average of 1.5 Mk 48 EXTORPs would be launched per Scenario 3. An average of 0.5 torpedoes would be used per scenario 2 and 4.

• **Submarine Sonar** – The prosecuting submarine pings infrequently (one ping/hour) in Scenario 3 and is silent in the other scenarios.

• **Mk 46 Torpedoes** – An average of 0.82 Mk 46 EXTORPS would be launched per Scenario 1. An average of 0.80 Mk 46 EXTORPS would be launched per Scenario 2. An average of 1.56 Mk 46 EXTORPS would be launched per Scenario 4.

The following data were collated for each acoustic source:

• Platform speed
• Source center frequency
• Source output levels
• Source pulse length and repetition rate
• Source beam widths (horizontal and vertical)
• Operating depth(s)

When multiple operating modes or depths were modeled for a source, the characteristics for each were uniquely identified. Some sources such as the surface sonar have variable operating parameters. In these cases, the Fleet defined typical operational characteristics based on its expectations in the USWTR environment.

### 4.3.6 Acoustic Environment Data

Four types of data are used to define the acoustic environment for each analysis site.

• **Seasonal Sound Velocity Profiles (SVPs)** – Seasonal SVPs for the range sites were obtained from the Generalized Digital Environmental Model, Variable (GDEMV) resolution of the Oceanographic and Atmospheric Master Library (OAML). These data are available through the Naval Oceanographic Office’s (NAVOCEANO) Data Warehouse. Any single observation taken at the range sites will necessarily vary from the seasonal mean. Sites A, B, and C are subject to the meanders of the Gulf Stream, and variations on a daily basis are expected. Site D is out of the direct influence of the Gulf Stream but is subject to intrusions of warm-core rings breaking off and drifting into the area. Training scenarios were evenly distributed through all four seasons.

• **Seabed Geoacoustics** – The type of sea floor influences how much sound is absorbed and how much sound is reflected back into the water column. For Sites
A and B, the seafloor description was obtained from the MRA for the JAX/CHASN Operating Area (DoN, 2008n). For Site C, bottom characteristics were generated from a combination of sources, including side-scan and sub-bottom profiler data from the U.S. Naval Ship (USNS) *Kane*. Data from the USNS *Kane* included side-scan sonar data that provided information on the roughness of the sea floor, echo-sounder data that provided information on bottom hardness, and bottom sampling to validate the side-scan and echo-sounder geological characterization data. For Site D, data on bottom type were obtained from a Woods Hole Oceanographic Institution (WHOI) report. Results at Site D delineated the site into the sandy-bottom continental shelf regime and the muddy-sediment-bottom continental slope regime.

- **Wind Speeds** – Several environmental inputs, such as wind speed, are necessary to model acoustic propagation on the prospective ranges. Wind speeds were averaged for each season to correspond to the seasonal velocity profiles. At the proposed Sites A and B USWTR, seasonal wind speeds ranged from 0.8 to 2.6 m/s. At Sites C and D they ranged from 4.5 to 5.5 m/s (14.7 to 18.2 ft/s), and 4.6 to 5.8 m/s (15 to 19.2 ft/s), respectively.

- **Bathymetry** – Bathymetry data for the Sites A and B area were obtained from the NAVOCEANO’s Digitized Bathymetric Data Base - Variable Resolution (DBDB-V). The resulting bathymetry map covers a larger area than the range area to account for acoustic energy propagating off the test area.

  Bathymetry data for the Site C USWTR were obtained from the NOAA National Data Center Coastal Relief East Coast CD-ROM databases. The bathymetry contours were extended off the surveyed area into deeper water to cover the extent of acoustic propagation. The resulting bathymetry map covers a much larger region (150 by 110 km [93 by 68 mi]) than the range area; therefore, acoustic energy propagating off the test area can be accounted for.

  Bathymetry data for Site D were obtained from the National Geophysical Data Center, Coastal Relief Model (Volume II). The bathymetry contours did not need to be extended off the surveyed area, as the database covered the entire area of study. The other edges of the region were automatically treated as projections of the edge for the analysis. The resulting bathymetry map covers a much larger region (130 by 100 km [81 by 62 mi]) than the range area; therefore, acoustic energy propagating off the test area can be accounted for.

### 4.3.7 Acoustic Effect Analysis Modeling

The modeling occurred in five broad steps. An overview of each step is provided below and a flow diagram of the process is shown in Figure 4.3-7. Results were calculated on a per-scenario
Calculate prop loss for each combination of - analysis site - season - active system - source use case

Includes surface and bottom boundary effects, absorption, and multi-path reception.

Create acoustic footprints for each propagation loss combination.

Model source movements over the analysis area.

Calculate receive levels and transmission time for each ping at each geographic cell analysis area.

For each cell of analysis area calculate the total energy flux density for all received pings.

Compare total energy flux of each cell to harassment criteria and calculate harassment areas.

For each source, scenario and mammal combination calculate potential harassment and estimate Level A and Level B takes.

Take Estimation Model (Excel)
basis and are summed to annual totals. Acoustic propagation and mammal population data are analyzed by season. The analysis estimated the sound exposure for marine mammals produced by each active source type independently.

- **Step 1.** Perform a propagation analysis for Level A and Level B harassment zones (based on the criteria and thresholds defined in Subchapter 4.3.3) using spherical spreading loss and the Navy’s Gaussian Ray Bundle (GRAB) program, respectively.

- **Step 2.** Convert the propagation data into a two-dimensional acoustic footprint for each of the acoustic sources.

- **Step 3.** Calculate the SEL and maximum received energy level (SPL) for each range cell area. For SEL each range cell area has accumulated all received pings.

- **Step 4.** Compare the total SEL to the physiological harassment thresholds and determine the area at or above the threshold to arrive at a marine mammal effect area for Level A (PTS) and Level B (TTS). For cells beyond the range of the 195 dB SEL threshold, compute the area using the risk function for all SPL levels 120 dB or greater to evaluate Level B behavioral harassment.

- **Step 5.** Multiply the harassment areas by the corresponding mammal population densities for the appropriate NODE sector to produce species sound exposure rates. The GIS-based NODE data are accessed by bounding the area of interest, even when it covers different habitat regions. The NODE report created average species densities for the overall geographic area requested. Apply the exposure rate to the scenario descriptions to generate annual sound exposure estimates. Apply these exposure estimates to produce annual incidental harassment estimates.

### 4.3.7.1 Description of Steps

**Propagation Analysis – Step 1**

The initial modeling step consists of calculating the propagation loss functions for Level A and Level B threshold analyses. The thresholds for Level A and Level B harassment analyses were developed in Subchapters 4.3.2 and 4.3.3.

**Level A Propagation Modeling**

In comparing the threshold level for Level A harassment to the source characteristics for the systems analyzed, it was apparent that detailed propagation analysis would overcomplicate the analysis without significant benefit. This is due to the short distances necessary to reach the Level A thresholds with spherical spreading losses alone. An example is shown in Table 4.3-6.
for a source assumed to ping with a pulse duration of 1 second. As a result of these short distances, few or no surface and bottom interactions occur and absorption is negligible in comparison to the spreading losses. Also, there is little accumulation of energy from multiple pings above or near the thresholds for the moving sources.

<table>
<thead>
<tr>
<th>Source Level (dB re $\mu$Pa @ 1 m)</th>
<th>Ping Length (s)</th>
<th>Total SEL (dB re 1 $\mu$Pa$^2$ s)</th>
<th>Level A Threshold (dB re 1 $\mu$Pa$^2$ s)</th>
<th>Allowable Spreading Loss (dB)</th>
<th>Distance to Reach Level A Threshold (20 Log R) m</th>
</tr>
</thead>
<tbody>
<tr>
<td>215</td>
<td>1</td>
<td>215.00</td>
<td>215</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>220</td>
<td>1</td>
<td>220.00</td>
<td>215</td>
<td>5.00</td>
<td>1.8</td>
</tr>
<tr>
<td>225</td>
<td>1</td>
<td>225.00</td>
<td>215</td>
<td>10.00</td>
<td>3.1</td>
</tr>
<tr>
<td>230</td>
<td>1</td>
<td>230.00</td>
<td>215</td>
<td>15.00</td>
<td>5.6</td>
</tr>
</tbody>
</table>

The Level A harassment range corresponds to that for each ping independently. Thus, to determine the Level A harassment range for each source, propagation losses were modeled equal to spherical spreading. For sources where multiple pings from a single point would occur, such as the dipping sonar, the harassment range was defined by the total SEL from all pings at each transmission point.

Some caveats exist for the Level A harassment analysis, all of which produce an expectation of very rare or no Level A harassment. Despite this low likelihood, assessment of Level A harassment was included using the following methodology for completeness.

- For the physically larger sources (i.e., the surface ship and submarine sonars), the Level A harassment ranges would be within the near field of the acoustic transducers. In this circumstance, the actual levels received by any mammal would be limited by the shielding effect of the sonar’s structure.

- The analysis assumes that the acoustic energy is constant throughout the vertical water column at a given horizontal range from the source. This is done to account for the lack of knowledge of the location of mammals in the water column. For short distances, the slant range between the source and mammal may significantly exceed the horizontal distance, resulting in a lower energy level actually being received versus the level modeled, and a corresponding overestimate of the potential for acoustic exposures within the Level A harassment zone.

- For lower-power sources, the harassment range may be less than the size of the mammal itself.
Level A harassment ranges for all sonars correspond to distances where striking the mammals is possible. Mitigation to avoid ship strikes of mammals simultaneously eliminates the potential for Level A harassment.

**Level B Propagation Modeling**

Propagation analysis for Level B acoustic harassment estimates is performed using the Comprehensive Acoustic Simulation System (CASS) using the GRAB model. The CASS/GRAB model is an acoustic model developed by NUWC for modeling active acoustic systems in a range-dependent environment. This model has been approved by the OAML for acoustic systems that operate in the 150 Hz to 100 kHz frequency range. The OAML was originally created in 1984 to provide consistency and standardization for all oceanographic and meteorological programs used by the Navy. Today the OAML’s role is expanded to provide the Navy a standard library for meteorological and oceanographic databases, models, and algorithms.

CASS/GRAB provides detailed multi-path propagation information as a function of range and bearing. GRAB allows range-dependent environmental information input so that, for example, as bottom depths and sediment types change across the range, their acoustic effects can be modeled.

Propagation loss functions for each unique combination (i.e., acoustic source, season, source depth, etc.) are produced at 45-degree bearing angles versus range and depth from three chosen analysis points. For each bearing angle, the maximum receive level curve is used to populate all angles around the source, plus or minus 22.5 degrees. This results in a continuous 360-degree characterization of the receive level from the source. The three representative points are used to characterize acoustic propagation in different depth regimes to reflect the topography of the site. The analysis is performed to a distance of 100 km (330,000 ft) at intervals in distance and depths of 5 m (16 ft).

A means of representing propagating sound is by acoustic rays. As acoustic rays travel through the ocean, their paths are affected by absorption, back-scattering, reflection, boundary interaction, etc. The CASS/GRAB model determines the acoustic ray paths between the source and a particular location in the water which, in this analysis, is referred to as a receive cell. The rays that pass through a particular point are called eigenrays. Each eigenray, based on its intensity and phase, contributes to the complex pressure field, hence the total energy received at a point. By summing the modeled eigenrays, the total received energy for a receive cell is calculated. This is illustrated in Figure 4.3-8. The propagation losses are normally less than those predicted by spherical spreading versus range due to the multiple eigenrays present.
Energy received at a particular point from multiple ray paths is summed to calculate the total received energy for that point.
Propagation Model Considerations

The total SEL for all pings will exceed the level of the most-intense ping when multiple pings are received. To calculate the accumulation of energy from multiple pings, the acoustic propagation analysis must be done up to a distance ensuring that the potential for cumulative energy exceeding the threshold is assessed. The extent to which receive levels need to be accumulated depends on the source operational characteristics, including source level, source movement, ping duration, and ping repetition rate. For calculating Level B harassment using the risk function, the propagation analysis must be performed up to the range at which the maximum SPL received is 120 dB. Based on an examination of these parameters, propagation losses for all sources were calculated to a distance of 100,000 m (330,000 ft).

Acoustic Footprint Generation and Source Movement Modeling – Step 2

Figure 4.3-9 displays a sample propagation loss function for a single bearing angle, where “N” represents source level. These curves are produced by selecting the maximum receive levels in the vertical water column at each horizontal distance. The propagation loss curves are then converted into a two-dimensional acoustic footprint. First, the SEL is calculated by applying the source’s output level and duration to the propagation loss function. For calculating exposures using the risk function criteria, only the maximum SPL is recorded in each cell. Second, the result for each bearing line is spread to cover a 45-degree wedge. This step is illustrated in Figure 4.3-10. For horizontally directional sources, the beam width is applied to produce the final acoustic footprint.

The acoustic footprint represents the ping coverage from each transmission point as the movement of the source is modeled. Representative ship tracks are used for moving sources: surface ship sonars, torpedo sonar, and dipping sonar. Each source is modeled independently; footprints are assumed not to overlap. As the movement is modeled, the ping’s receive level at all points covered by the acoustic footprint is recorded at each point. Both the acoustic footprint and receive cells are defined to represent areas of 25 by 25 m (82 by 82 ft), or 0.000625 km² (0.0001822 NM²).

SEL Calculation – Step 3

For each of the receive area cells, the total SEL is calculated for all received pings recorded for that area cell. SEL is calculated by using the SEL equation presented in Appendix C, as follows:

\[
SEL = SPL + 10 \log_{10} \frac{T}{g^{14/g^{32}}}
\]

where SEL has units of dB re 1 μPa²-s, SPL has units of dB re 1 μPa, and T is in seconds.
Relative Received Level vs Range

Figure 4.3-9

Range (m)

Relative Received Level (dB)

N
N-10
N-20
N-30
N-40
N-50
N-60
N-70
N-80
N-90
N-100

0 100 200 300 400 500 600 700 800 900 1000
Bearing Angles for CASS

(Radius = 1 Km)
Marine Mammal Effect Area Analysis – Step 4

The physiological harassment exposures for each species are generated by comparing the total calculated SEL for each receive cell to the Level B harassment threshold of 195 dB re μPa²-s, and the cells >= 195. The total harassment area is then calculated by multiplying the number of cells by the area per cell, 0.000625 km² (0.0001822 NM²). The total harassment area is then multiplied by the densities for each species at those respective cells. Densities are given using the Navy OPAREA Density Estimates (NODEs) database and are converted to animals/cell throughout the range. The total number of harassment exposures for each species is then calculated by summing the results.

The behavioral exposures are determined by finding all cells greater than 120 dB SPL and beyond the range of the 195 dB SEL threshold, applying the risk curve to those cells and multiplying the risk (0.0 – 1.0) times the area for that cell. The total harassment area is then multiplied by the densities for each species at those respective cells. The total number of behavioral exposures for each species is then calculated by summing the results.

Annual Marine Mammal Acoustic Effect Estimation – Step 5

To determine the mammal harassment estimates, the total harassment area for each source is converted to a harassment rate (i.e., harassment areas multiplied by the corresponding mammal population densities). This is done for each mammal distribution region and for both Level A and Level B criteria thresholds. Level A harassment areas are subtracted from Level B harassment areas to prevent double-counting incidents. Additionally, harassment areas between 195 dB SEL and 215 SEL representing Level B TTS exposures are also subtracted from the remaining Level B harassment area prior to applying the risk function curves to avoid double-counting. The TTS exposures are later summed with the risk function exposures to provide a total number of potential Level B harassment exposures. For the surface and dipping sonars, the harassment area is expressed in area per kilometer of movement. The torpedo area is calculated per run and the submarine area is expressed in area per ping. For the dipping sonars, the harassment rate is expressed as the exposures per dip.

The harassment rates for each source are used to estimate species harassment rates by multiplying the harassment rate by the corresponding mammal population density (based on the depth region). This is done for every species and all four seasons. The results from each depth region are summed to produce a species harassment rate used in the final calculations. For Level B behavioral harassment occurring at received energy levels below what would elicit TTS, the risk function was applied. Specifically, the equation below was implemented for this analysis:

\[ R(L) = \frac{1}{1 + \left[ \frac{K}{L - B} \right] ^ A} \]

where,
- \( R = \) risk (0 – 1.0)
- \( L = \) received level (RL; in units of dB)
B = basement RL in dB; 120 dB
K = RL increment above basement in dB at the 50% risk level; 45 dB
A = risk transition sharpness parameter
  = 10 for odontocetes (except harbor porpoises) and pinnipeds; 8 for mysticetes

For both mysticetes and odontocetes (except harbor porpoises)/pinnipeds, the 99% RL was 195 dB.

The species harassment rates are multiplied by the operational duty cycle for each source, the length of each scenario, and the number of yearly scenario occurrences. This produces the estimated number of animals incidentally harassed annually for each combination of source, season, and animal. An example of this process is presented in Table 4.3-7. The only exception is for harbor porpoises for which all animals that are predicted to receive greater than 120 dB re 1μPa are considered to be acoustically harassed. However, due to the lack of sufficient harbor porpoise density data for the USWTR areas, it was not possible to quantitatively predict acoustic effects.

Subchapters 4.3.8 and 4.3.9 contain analyses for each individual species at each of the USWTR alternative sites.

When analyzing the results of the acoustic effects modeling to provide an estimate of effects, it is important to understand that there are limitations to the ecological data and to the acoustic model, which in turn, leads to an overestimation (i.e., conservative estimate) of the total exposures to marine mammals. Specifically, the modeling results are conservative for the following reasons:

- Acoustic footprints for sonar sources are added independently and, therefore, do not account for overlap they would have with other sonar systems used during the same active sonar activity. As a consequence, the calculated acoustic footprint is larger than the actual acoustic footprint.

- Acoustic exposures do not reflect implementation of mitigation measures, such as reducing sonar source levels when marine mammals are present.

- In this analysis, the acoustic footprint is assumed to extend from the water surface to the ocean bottom. In reality, the acoustic footprint radiates from the source like a bubble, and a marine animal may be outside this region.
Example Calculation – Common Dolphin Level B Sound Exposure Estimate for SQS-53 Operation in Scenario 2 During Autumn at the Proposed Site D USWTR

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly Scenario Occurrences</td>
<td>30</td>
</tr>
<tr>
<td>Scenario Duration</td>
<td>6 hours</td>
</tr>
<tr>
<td># of Surface Sonar Platforms in the Scenario</td>
<td>1</td>
</tr>
<tr>
<td># of Total Source 53 Platforms Used (70% of total surface sonars)</td>
<td>0.7</td>
</tr>
<tr>
<td># of Total Source Platforms Used in Autumn</td>
<td>5.25</td>
</tr>
<tr>
<td>Operational Duty Cycle with Helicopters</td>
<td>50%</td>
</tr>
<tr>
<td>Ship Speed (km/hr)</td>
<td>18.52</td>
</tr>
<tr>
<td>Search Mode Operational % (split with track mode)</td>
<td>67%</td>
</tr>
<tr>
<td>Applicable Species Harassment Rate</td>
<td>0.394744</td>
</tr>
<tr>
<td>53 Search Mode Exercise Harassment Incidents</td>
<td>77.1457</td>
</tr>
<tr>
<td>53 Search Mode Exercise Harassment Incidents with Unidentified Species</td>
<td>118.187</td>
</tr>
</tbody>
</table>

Notes: This is an example looking at the SQS-53 in search mode in autumn and the estimated Level B harassment of common dolphin, as follows:

1. Determine the number of times this scenario will be executed in autumn = yearly scenario occurrences (30) x # of surface sonar platforms (1) x # of SQS-53 platforms (0.7) x 0.25 (one season out of four) = (30*1*0.7*0.25) = 5.25 (the number of total source platforms used in autumn – SQS-53).

2. Determine the amount of time the system is operational = # of total source platforms used in autumn (5.25) x operational duty cycles with helicopters (0.50) x scenario duration (6) x search mode operational % (0.67) = (5.25*0.50 x 6*0.67) = 10.55 hours.

3. The amount of time the system is operational (10.55 hours) is multiplied by the ship speed in km/hr (18.52) x species harassment rate (animals/km) (0.394744) = (10.55*18.52* 0.394744) = 77.1457 = SQS-53 search mode exercise harassment incidents in autumn.

This species harassment rate value does not appear elsewhere in the document because it is representative of a particular species for a particular sonar.
4.3.7.2 Species with Possible Occurrence but Not Modeled

Exposure numbers for three species occurring within the USWTR sites could not be calculated due to the lack of appropriate data needed to generate density estimates. However, potential effects to these species were qualitatively analyzed. These three species are the following:

- Sei whale (Sites C and D)
- Atlantic white-sided dolphin (Site D)
- Harbor porpoise (Sites C and D)

In addition, 12 species have no density estimate since their occurrence is limited near the USWTR sites. Therefore, for modeling purposes, these species have a functional density of zero and no potential effects are predicted. These species are the following:

- Bryde’s whale
- Sei whale (Sites A and B)
- Blue whale
- Spinner dolphin
- Fraser’s dolphin
- White-beaked dolphin
- Atlantic white-sided dolphin (Sites A, B, and C)
- Melon-headed whale
- Pygmy killer whale
- False killer whale
- Killer whale
- Harbor porpoise (Sites A and B)

As discussed in Subchapter 3.3, because manatees inhabit bays, rivers, lakes, and coastal waters, they would lie outside of the operating range of the USWTR, with the exception of maintenance and ship object detection/navigational sonar training. Although manatees would not be present on the USWTR, in some very limited instances they could be in coastal waters (very close to shore) and potentially hear sonar from the range. Exposure numbers for the manatees occurring in the southeast could not be calculated due to the lack of acoustic exposure criteria and lack of available density information.

Behavioral data on two animals indicate an underwater hearing range of approximately 0.4 to 46 kHz, with best sensitivity between 16 and 18 kHz (Gerstein et al., 1999), while earlier electrophysiological studies indicated best sensitivity from 1 to 1.5 kHz (Bullock et al., 1982). Therefore, it appears that manatees have the capability of hearing active sonar. In one study, manatees were shown to react to the sound from approaching or passing boats by moving into deeper waters or increasing swimming speed (Nowacek et al., 2003). By extension, manatees could react to active sonar; however, there is no evidence to suggest the reaction would likely disturb the manatee to a point where their behaviors are abandoned or significantly altered. Specifically, manatees did not respond to sound at levels of 10 to 80 kHz produced by a pinger.
every 4 seconds for 300 milliseconds (Bowles et al., 2001). The pings’ energy was predominantly in the 10 to 40 kHz range (the mid to high portion of manatee hearing). The level of sound was approximately 130 dB re 1 μPa.

Additionally, Hubbs-SeaWorld Research Institute initially tested a manatee detection device based on sonar (Bowles et al., 2004). In addition to conducting sonar reflectivity, the experiments also included a behavioral response study. Experiments were conducted with 10 kHz pings, whereby the sound level was increased by 10 dB from 130 dB to 180 dB or until the researchers observed distress. Rapid swimming, thrashing of the body or paddle, and spinning while swimming indicated distress. Researchers found that manatees detected the 10 kHz pings and approached the transducer cage when the sonar was turned on initially. However, none of the responses indicated that the manatees responded with intense avoidance or distress. The authors concluded that manatees do not exhibit strong startle responses or an aggressive nature towards acoustic stimuli, which differs from experiments conducted on cetaceans and pinnipeds (Bowles et al., 2004).

Based on best available science, manatees would hear mid-frequency and high-frequency sonar, but would not likely show a strong reaction or be disturbed from their normal range of behaviors. Additionally, limited active sonar activities would take place in the vicinity of manatee habitat. The distance from the USWTR to a manatee that, on rare occasions, could be in the open ocean would be almost 93 km (50 NM). At this distance, the sound levels from sonar use on the USWTR would have dropped below the levels that have been measured to have caused a reaction in manatees. As for the extralimital species listed above, therefore, for modeling purposes, the manatee has a functional density of zero and no potential effects are predicted.

### 4.3.8 Anticipated Acoustic Exposures to ESA-Listed Marine Mammals

The Navy has prepared a report that describes the input data and analysis methods used to estimate the number of marine mammals that could be affected by the operation of Navy tactical acoustic sonar systems at the four potential USWTR sites (DoN, 2008a). This report is available on the USWTR Web site (http://projects.earthtech.com/uswtr/USWTR_library/PDF_library/Technical_Report/TR11899_Gilchrest-Fetherston-Neales20081028.pdf).

As discussed in detail in this subchapter, the Navy concludes that the use of the proposed USWTR has the potential to affect certain endangered marine mammals, and thus, ESA consultation with the NMFS is appropriate for this action. The Navy’s assessment indicates that the proposed action will not adversely modify or destroy any critical habitats, nor will the action jeopardize the continued existence of any listed species.

Subchapters 4.3.8.1 through 4.3.8.4 analyze the potential for actions at each of the proposed USWTR locations to affect endangered marine mammals. For the preferred alternative, the Navy findings in this subchapter are the subject of on-going ESA consultation. In the event that one of
the alternative sites becomes the Navy’s preferred alternative through the OEIS/EIS process, the Navy would initiate the appropriate ESA consultation for that alternative.

When analyzing the results of the acoustic effect modeling to provide an estimate of harassment, it is important to understand that there are limitations to the ecological data used in the model, and to interpret the model results within the context of a given species’ ecology. In particular, density estimates used in the model were calculated for an area much larger than the range itself, encompassing a diverse swath of habitats beginning with inshore coastal environments and moving to the shelf edge and pelagic systems well offshore in the Gulf Stream (refer to Subchapter 3.3.2 for a summary). Although the model differentiates between off-shelf and on-shelf depth strata, actual distributions of animals are patchy and more isolated than they appear in the density estimates used.

When reviewing the acoustic effect modeling results, it is also important to understand that the estimates of marine mammal sound exposures are presented without consideration of mitigation. The Navy will work through the ESA consultation process to evaluate the mitigation measures to reduce the potential for incidental takes of ESA-listed species (described in detail in Chapter 6). Based on the ongoing consultation and the consideration of mitigation with the NMFS, the Navy has requested authorization under ESA for any listed species for which the NMFS concludes that incidental takes may occur.

As described in an earlier subchapter, with respect to discussing effects in terms of the acoustic modeling results, ESA regulations provide guidance as to what should be considered when determining effects. The following subchapters address these issues as they apply to ESA-listed marine mammals.

The annual ESA acoustic exposures for the proposed USWTR locations are presented in Table 4.3-8 for Site A, Table 4.3-9 for Site B, and Table 4.3-10 for Site C, and Table 4.3-11 for Site D.

4.3.8.1 Site A

Four ESA-listed marine mammal species may be present in the JAX OPAREA. These are the North Atlantic right whale, humpback whale, fin whale, and sperm whale. Sei and blue whales are not expected to occur at the proposed Site A USWTR.

There are so few sightings of fin and sperm whales in the JAX OPAREA that the resulting density estimates are zero. However, these species may occur in the proposed Site A USWTR and require consultation with the NMFS to determine potential impacts. This subchapter analyzes potential acoustic impacts to the ESA-listed marine mammals that may occur in the JAX OPAREA.

In the rare event that an ESA-protected marine mammal is present on the proposed Site A USWTR, it is unlikely that range use would create a significant likelihood of injury to the
animal. Mitigation and monitoring measures (listed in Chapter 6) further reduce any potential for adverse impacts to protected species.

In accordance with ESA requirements, the Navy has initiated consultation with the NMFS for use of Site A as the preferred alternative. The Navy’s findings, presented in this subchapter, are the subject of this ongoing consultation. Through the consultation process and the implementation of mitigation measures (see Chapter 6) to further reduce the potential for adverse affects to marine mammals, no significant impacts to ESA-listed species are likely to occur as a result of installation and operation of the USWTR at the proposed Site A USWTR.

Table 4.3-8
Estimate of Marine Mammal Acoustic Exposures for Annual Operations on the Proposed USWTR Site A

<table>
<thead>
<tr>
<th>Species</th>
<th>PTS</th>
<th>TTS</th>
<th>Non-TTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESA-Listed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Atlantic Right Whale</td>
<td>0</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Humpback Whale</td>
<td>0</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>Fin Whale</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sperm Whale</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Non-ESA-Listed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minke Whale</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Pygmy/dwarf Sperm Whales</td>
<td>0</td>
<td>3</td>
<td>163</td>
</tr>
<tr>
<td>Beaked Whales(^1)</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Rough-toothed Dolphin</td>
<td>0</td>
<td>1</td>
<td>77</td>
</tr>
<tr>
<td>Bottlenose Dolphin</td>
<td>4</td>
<td>747</td>
<td>49,757</td>
</tr>
<tr>
<td>Pantropical Spotted Dolphin</td>
<td>0</td>
<td>59</td>
<td>3,586</td>
</tr>
<tr>
<td>Atlantic Spotted Dolphin</td>
<td>3</td>
<td>808</td>
<td>46,558</td>
</tr>
<tr>
<td>Striped Dolphin</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clymene Dolphin</td>
<td>0</td>
<td>28</td>
<td>1,713</td>
</tr>
<tr>
<td>Common Dolphin</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Risso’s Dolphin</td>
<td>0</td>
<td>29</td>
<td>2,554</td>
</tr>
<tr>
<td>Pilot Whales</td>
<td>0</td>
<td>24</td>
<td>1,810</td>
</tr>
</tbody>
</table>

Notes: These estimates are prior to implementation of mitigation measures (Chapter 6).

\(^1\) Beaked whale species here are assumed to include *Mesoplodon europaeus*, *M. densirostris*, *M. mirus*, and *Ziphius cavirostris*. 
Table 4.3-9
Estimate of Marine Mammal Acoustic Exposures
for Annual Operations on the Proposed USWTR Site B

<table>
<thead>
<tr>
<th>Species</th>
<th>PTS</th>
<th>TTS</th>
<th>Non-TTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESA-Listed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Atlantic Right Whale</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Humpback Whale</td>
<td>0</td>
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<tr>
<td>Sperm Whale</td>
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<tr>
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<tr>
<td>Minke Whales</td>
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<td>1</td>
</tr>
<tr>
<td>Pygmy/dwarf Sperm Whales</td>
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<td>29</td>
</tr>
<tr>
<td>Beaked Whales	extsuperscript{1}</td>
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<td>0</td>
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<td>Common Dolphin</td>
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<td>Risso’s Dolphin</td>
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<tr>
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<td>0</td>
<td>15</td>
<td>749</td>
</tr>
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</table>

Notes: These estimates are prior to implementation of mitigation measures (Chapter 6).
	extsuperscript{1} Beaked whale species here are assumed to include *Mesoplodon europaeus*, *M. densirostris*, *M. mirus*, and *Ziphius cavirostris*. 
### Table 4.3-10

Estimate of Marine Mammal Acoustic Exposures for Annual Operations on the Proposed USWTR Site C

<table>
<thead>
<tr>
<th>Species</th>
<th>PTS</th>
<th>TTS</th>
<th>Non-TTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESA-Listed</strong></td>
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<tr>
<td>North Atlantic Right Whale</td>
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<td>0</td>
<td>3</td>
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<td>Humpback Whale</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sei Whale</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Fin Whale</td>
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<td>0</td>
</tr>
<tr>
<td>Sperm Whale</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Non-ESA-Listed</strong></td>
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<td></td>
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<tr>
<td>Minke Whale</td>
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<td>0</td>
<td>8</td>
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<tr>
<td>Pygmy/dwarf Sperm Whale</td>
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<td>162</td>
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<td>0</td>
<td>3</td>
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<tr>
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<td>6</td>
<td>349</td>
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<tr>
<td>Pilot Whales</td>
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<td>3</td>
<td>539</td>
</tr>
<tr>
<td>Harbor Porpoise&lt;sup&gt;2&lt;/sup&gt;</td>
<td>-</td>
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</tr>
</tbody>
</table>

**Notes:** These estimates are prior to implementation of mitigation measures (Chapter 6).

<sup>1</sup> Beaked whale species here are assumed to include *Mesoplodon europaeus*, *M. densirostris*, *M. mirus*, and *Ziphius cavirostris*.

<sup>2</sup> Insufficient data exists to calculate density estimates for these species in the CHPT OPAREA, however rare observations have been made indicating that these species may be present in the OPAREA.
### Table 4.3-11

Estimates of Marine Mammals Acoustic Exposures for Annual Operations on the Proposed USWTR Site D

<table>
<thead>
<tr>
<th>Species</th>
<th>PTS</th>
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<th>Non-TTS</th>
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<td>0</td>
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<td>Sei Whale&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>Fin Whale</td>
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<td>0</td>
<td>6</td>
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<tr>
<td>Pygmy/dwarf Sperm Whale</td>
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<td>135</td>
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<td>128</td>
</tr>
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<td>Atlantic White-sided Dolphin&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>-</td>
<td>-</td>
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<td>Rough-toothed Dolphin</td>
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<td>1</td>
<td>64</td>
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<td>Pilot Whales</td>
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<td>3,632</td>
</tr>
<tr>
<td>Harbor Porpoise&lt;sup&gt;2&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**

- These estimates are prior to implementation of mitigation measures (Chapter 6).
- Beaked whale species here are assumed to include *Mesoplodon europaeus*, *M. densirostris*, *M. mirus*, and *Ziphius cavirostris*.
- Insufficient data exists to calculate density estimates for these species in the VACAPES OPAREA, however rare observations have been made indicating that these species may be present in the OPAREA.
North Atlantic Right Whale – Site A

North Atlantic right whales migrate to the coastal waters of the southeastern U.S. to calve during the winter months (November through March). The coastal waters off Georgia and northern Florida are the only known calving ground for the North Atlantic right whale. During the summer, North Atlantic right whales should occur further north on their feeding grounds; however, North Atlantic right whales might be seen anywhere off the Atlantic U.S. throughout the year (Gaskin, 1982). As noted by Kraus et al. (1993), North Atlantic right whale sightings have been opportunistically reported off the southeastern U.S. as early as September and as late as June in some years. Recently, a mother and calf pair was sighted off of northeastern Florida in July (NOAA Fisheries Service, 2007). The North Atlantic right whale may occur year-round from the shore to the continental shelf break in the JAX OPAREA (including the proposed Site A USWTR), with a peak concentration during November through March.

No Level A exposures are expected for North Atlantic right whales on the proposed Site A USWTR. Acoustic analysis indicates that up to 48 North Atlantic right whale may be exposed to levels of sound likely to result in Level B harassment. This is a conservative prediction for the following reasons:

- Because this species is highly endangered, the use of the maximum number of right whales potentially on the calving grounds was used as the basis for calculating density. The estimated abundance of right whales was applied uniformly across the entire shelf region – a much larger area than the known “high use habitat.” This results in an overestimate of density in the area of the proposed Site A USWTR, because they are rarely found in the deeper, offshore waters. Therefore, the acoustic model overestimates the potential effects in comparison to the whales’ actual spatial distribution.

- Although there have not been studies evaluating acoustic disturbance of migrating right whales, Richardson (1999) studied reactions of bowhead whales to seismic surveys during their autumn migration. While bowheads avoided the area within 20 km (10.8 NM) of operating airguns, they were common in the same location on days that surveys were not underway. Because of the similarity between right whales and bowheads, it may be inferred that even in the unlikely event a right whale was momentarily disturbed by active acoustics, it would not exhibit long-term displacement in the area of the proposed range, nor would the overall migratory pattern be significantly affected.

In terms of functional hearing capability, right whales belong to low frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. Right whale functional hearing overlaps with the frequencies produced by mid-frequency and high frequency active sonars. However, right whales apparently do not hear some low frequencies well. Right whale hearing capability was estimated using a mathematical model which predicted a hearing range of 10 Hz to 22 kHz, and a functional hearing range of 15 Hz to 18 kHz (Parks et al. 2007). Nowacek et al. (2004) noted a
response to short tones and down sweeps at 0.5 to 4.5 kHz, but not to vessel noise of 0.05 to 0.5 kHz. Frequencies of high-frequency active sonar above the right whale upper functional hearing range of 18 kHz may not result in a behavioral reaction.

According to the North Atlantic right whale report card released annually by the North Atlantic Right Whale Consortium, approximately 393 individuals are thought to occur in the western North Atlantic (NARWC, 2007). The most recent NOAA SAR states that in a review of the photo-id recapture database for June 2006, 313 individually recognized whales were known to be alive during 2001 (Waring et al., 2008). This is considered the minimum population size for right whales in the North Atlantic.

Detection probabilities for a group of North Atlantic right whales at the surface range from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f,g).

Based on best available science and the distance of the range from right whale critical habitat, the Navy concludes that exposures to North Atlantic right whales on the proposed Site A USWTR would result in short-term effects to individuals exposed and would likely not affect annual rates of recruitment or survival. The mitigations presented in Chapter 6 would further reduce the potential for exposures to occur to North Atlantic right whales.

In accordance with NEPA, there would be no significant impact to North Atlantic right whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to North Atlantic right whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

In accordance with the ESA, the Navy finds that activities on the proposed Site A USWTR may affect North Atlantic right whales. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.

**Humpback Whale – Site A**

Humpback whales are expected to occur throughout the JAX OPAREA (including the proposed Site A USWTR) during fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. Humpback whales are not expected in the OPAREA during summer, since they should occur further north on their feeding grounds.

Acoustic analysis indicates that up to 108 humpback whales may be exposed to levels of sound likely to result in Level B harassment on the proposed Site A USWTR (Table 4.3-8). The exposure estimate represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. Acoustic analysis indicates that no humpback whales would be exposed to sound levels likely to result in Level A harassment.
In terms of functional hearing capability, humpback whales belong to low-frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. Recent information on the songs of humpback whales suggests that their hearing may extend to frequencies of at least 24 kHz (Au et al., 2006). Filter-bank models of the humpback whale’s ear suggest that humpbacks are sensitive to frequencies between 30 Hz and 18 kHz, with best sensitivity between 700 Hz and 10 kHz (Helweg et al., 2000; Houser et al., 2001a). Exposure to high-frequency active sonar that is above the functional hearing capability of humpback whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Humpbacks in the vicinity of the proposed USWTR site are most likely migrating to or from the Caribbean wintering grounds; thus, it is beneficial to examine studies performed on other populations of migrating humpbacks. McCauley and others (1998) investigated reactions of migrating humpbacks to seismic exploration off Exmouth, Western Australia. Although some animals displayed localized avoidance behavior, such displacements were short in duration and the overall migratory track of the whales was not significantly altered.

An estimated 11,570 humpback whales occur in the entire North Atlantic (Stevick et al., 2003a). Humpback whales in the North Atlantic are thought to belong to five different stocks based on feeding locations (Katona and Beard, 1990; Waring et al., 2008): Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, and Iceland. There appears to be very little exchange between these separate feeding stocks (Katona and Beard, 1990). The best estimate of abundance for the Gulf of Maine Stock is 847 individuals (Waring et al., 2008) based on a 2006 aerial survey. During the winter, most of the North Atlantic population of humpback whales is believed to migrate south to calving grounds in the West Indies region (Whitehead and Moore, 1982; T.D. Smith et al., 1999; Stevick et al., 2003). During this time individuals from the various feeding stocks mix through migration routes as well as on the feeding grounds. The mixing of multiple stocks through the migratory season suggests that exposures off the southeastern U.S. are likely spread across all of the North Atlantic populations. There are not sufficient data available to estimate the percentage of exposures to each stock.

Lookouts would likely detect humpback whales at the surface because of their large size (up to 16 m [53 ft]) (Leatherwood and Reeves, 1983) and pronounced vertical blow. Detection probabilities for a group of humpback whales at the surface have ranged from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f,g).

Based on best available science, the Navy concludes that exposures to humpback whales due to activities on the proposed Site A USWTR would result in short-term effects to individuals exposed and would likely not affect annual rates of recruitment or survival. The mitigation presented in Chapter 6 would further reduce the potential for exposures to occur to humpback whales.
In accordance with NEPA, there would be no significant impact to humpback whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to humpback whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site A USWTR may affect humpback whales. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.

**Fin Whale – Site A**

Fin whales may occur in the JAX OPAREA (including the proposed Site A USWTR) in the winter, spring, and fall from the shore to the 2,500-m isobath (DoN, 2008n). During the summer, fin whales should be on their feeding grounds at higher latitudes off the northeastern U.S. and are not expected to occur in the JAX OPAREA.

Acoustic analysis indicates that no fin whales will be exposed to levels of sound likely to result in either Level A or Level B harassment. No Level A or Level B exposures are expected for fin whales at the proposed Site A USWTR.

In terms of functional hearing capability, fin whales belong to the low-frequency group, which have best hearing ranging from 7 Hz to 22 kHz (Southall et al., 2007). Fin whale calls generally cover the 10 to 15 Hz frequency band and are less than 1 second in duration (Sirovic, 2006). Exposure to high-frequency active sonar that is above the functional hearing capability of fin whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

The NOAA SAR estimates that there are 2,269 individual fin whales in the U.S. Atlantic waters (Waring et al., 2008); this is probably an underestimate, however, as survey coverage of known and potential fin whale habitat is incomplete.

Lookouts would likely detect a group of fin whales at the surface because they have a high likelihood of detection (0.90 in Beaufort Sea States of 6 or less; Barlow, 2005).

In accordance with NEPA, there would be no significant impact to fin whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to fin whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site A USWTR may affect fin whales. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.
Sperm Whale – Site A

Worldwide, sperm whales exhibit a strong affinity for deep waters beyond the continental shelf break (Rice, 1989). Sperm whales are expected to occur seaward of the shelf break throughout the JAX OPAREA (including the proposed Site A USWTR) in all seasons.

There are so few sightings of sperm whales in the vicinity of the proposed Site A USWTR that the resulting density estimate is zero. No Level A or Level B exposures are expected for sperm whales at the proposed Site A USWTR.

Sperm whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007). The anatomy of the sperm whale’s inner and middle ear indicates an ability to best hear high frequency to ultrasonic frequency sounds. Sperm whales may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The ABR technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz, with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001). The intersection of common frequencies between sperm whale functional hearing and mid- and high frequency sonars suggests that more often than not there is a potential for a behavioral response. There is some likelihood that low frequency vocalizations and sound dependent behaviors may not be disrupted or may only be partially disrupted or masked because the sperm whale has a functional hearing range lower than mid-frequency active sonars.

The current combined best estimate of sperm whale abundance from Florida to the Bay of Fundy in the western North Atlantic Ocean is 4,804 individuals (Waring et al., 2008). Stock structure for sperm whales in the North Atlantic is unknown (Dufault et al., 1999).

Lookouts would likely detect a group of sperm whales at the surface because they have a high likelihood of detection (0.87 in Beaufort Sea States of 6 or less; Barlow, 2006) given their large size (up to 17 m [56 ft]) (Leatherwood and Reeves, 1983), pronounced blow (large and angled), and mean group size (approximately seven animals). However, as a deep diving species, sperm whales can stay submerged, and therefore visually undetectable, for over an hour.

In accordance with NEPA, there would be no significant impact to sperm whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to sperm whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site A USWTR may affect sperm whales. The Navy initiated consultation with the NMFS in accordance with Section 7 of the ESA for concurrence.
**4.3.8.2 Site B**

Four ESA-listed marine mammals may be present in the vicinity of the CHASN OPAREA. These are the North Atlantic right whale, humpback whale, fin whale, and sperm whale. The other two endangered whale species – sei and blue whales – are not expected to occur at the proposed Site B USWTR. There are so few sightings of fin and sperm whales in the CHASN OPAREA that the resulting density estimates are zero. Therefore, only potential impacts to the North Atlantic right whale and the humpback whale are discussed. However, these species may still occur in the proposed Site B USWTR.

**North Atlantic Right Whale – Site B**

North Atlantic right whales may occur during fall, winter, and spring in the CHASN OPAREA, but are most likely to occur during their fall and spring migrations to and from their calving grounds further south (Winn et al., 1986). Knowlton et al. (2002) analyzed sightings data collected in the mid-Atlantic from northern Georgia to southern New England and found that the majority of northern right whale sightings occurred within approximately 56 km (30 NM) from shore. The edge of the proposed Site B USWTR would be approximately 70 km (38 NM) from shore, outside of the main corridor.

The CHASN OPAREA was combined with the JAX OPAREA in the acoustic model. As discussed in the previous subchapter (4.3.8.1), acoustic analysis indicates that up to four North Atlantic right whales may be exposed to levels of sound likely to result in Level B harassment (Table 4.3-8). This is a conservative prediction. No Level A exposures are expected in the CHASN OPAREA.

In terms of functional hearing capability, right whales belong to low-frequency cetaceans which have best hearing ranging from 7Hz to 22 kHz. Right whale functional hearing overlaps with the frequencies produced by mid-frequency and high frequency active sonars. However, right whales apparently do not hear some low frequencies well. Right whale hearing capability was estimated using a mathematical model which predicted a hearing range of 10 Hz to 22 kHz, and a functional hearing range of 15 Hz to 18 kHz (Parks et al. 2007). Nowacek et al. (2004) noted a response to short tones and down sweeps at 0.5 to 4.5 kHz, but not to vessel noise of 0.05 to 0.5 kHz. Frequencies of high frequency active sonar above the right whale upper functional hearing range of 18 kHz may not result in a behavioral reaction.

According to the North Atlantic right whale report card released annually by the North Atlantic Right Whale Consortium, approximately 393 individuals are thought to occur in the western North Atlantic (NARWC, 2007). The most recent NOAA SAR states that in a review of the photo-id recapture database for June 2006, 313 individually recognized whales were known to be alive during 2001 (Waring et al., 2008). This is considered the minimum population size.

Detection probabilities for a group of North Atlantic right whales at the surface range from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f,g).
Based on best available science the Navy concludes that exposures to North Atlantic right whales on the proposed Site B USWTR may result in short-term effects and would likely not affect annual rates of recruitment or survival.

In accordance with NEPA, there would be no significant impact to North Atlantic right whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to North Atlantic right whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site B USWTR may affect North Atlantic right whales. Should Site B be selected as the Navy’s preferred alternative, the Navy would initiate ESA Section 7 consultation to reach concurrence with the NMFS.

### Humpback Whale – Site B

Humpback whales may occur throughout the CHASN OPAREA (including the proposed Site B USWTR) during fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. Humpback whales are not expected in the OPAREA during summer, since they should occur farther north on their feeding grounds.

Acoustic analysis indicates that up to 23 humpback whales may be exposed to levels of sound likely to result in Level B harassment on the proposed Site B USWTR (Table 4.3-9). No Level A exposures are expected.

In terms of functional hearing capability humpback whales belong to low-frequency cetaceans which have best hearing ranging from 7Hz to 22 kHz. Recent information on the songs of humpback whales suggests that their hearing may extend to frequencies of at least 24 kHz (Au et al., 2006). Filter-bank models of the humpback whale’s ear suggest that humpbacks are sensitive to frequencies between 30 Hz and 18 kHz, with best sensitivity between 700 Hz and 10 kHz (Helweg et al., 2000; Houser et al., 2001a). Exposure to high frequency active sonar that is above the functional hearing capability of humpback whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

An estimated 11,570 humpback whales occur in the entire North Atlantic (Stevick et al., 2003a). Humpback whales in the North Atlantic are thought to belong to five different stocks based on feeding locations (Katona and Beard, 1990; Waring et al., 2008): Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, and Iceland. There appears to be very little exchange between these separate feeding stocks (Katona and Beard, 1990). The best estimate of abundance for the Gulf of Maine Stock is 847 individuals (Waring et al., 2008) based on a 2006 aerial survey. During the winter, most of the North Atlantic population of humpback whales is believed to migrate south to calving grounds in the West Indies region (Whitehead and Moore, 1982; T.D. Smith et al., 1999; Stevick et al., 2003). During this time individuals from the...
various feeding stocks mix through migration routes as well as on the feeding grounds. The mixing of multiple stocks through the migratory season suggests that exposures off the southeastern U.S. are likely spread across all of the North Atlantic populations. There are not sufficient data available to estimate the percentage of exposures to each stock.

Lookouts would likely detect humpback whales at the surface because of their large size (up to 16 m [53 ft]) (Leatherwood and Reeves, 1982) and pronounced vertical blow. Detection probabilities for a group of humpback whales at the surface have ranged from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f,g).

In accordance with NEPA, there would be no significant impact to humpback whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to humpback whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site B USWTR may affect humpback whales. Should Site B become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Fin Whale – Site B**

Fin whales may occur in the CHASN OPAREA in the fall, winter, and spring. In the summer fin whales are likely to be found on feeding grounds to the north and not in the OPAREA. Fin whales may occur in the proposed Site B USWTR during fall, winter, and spring.

There are so few sightings of fin whales in the vicinity of the proposed Site B USWTR that the resulting density estimate is zero. No Level A or Level B exposures are expected for fin whales at the proposed Site B USWTR.

In terms of functional hearing capability fin whales belong to the low frequency group, which have best hearing ranging from 7 Hz to 22 kHz (Southall et al., 2007). Fin whale calls generally cover the 10 to 15 Hz frequency band and are less than 1 second in duration (Sirovic, 2006). Exposure to high frequency active sonar that is above the functional hearing capability of fin whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

The NOAA SAR estimates that there are 2,269 individual fin whales in the U.S. Atlantic waters (Waring et al., 2008); this is probably an underestimate, however, as survey coverage of known and potential fin whale habitat is incomplete.

Lookouts would likely detect a group of fin whales at the surface because they have a high likelihood of detection (0.90 in Beaufort Sea States of 6 or less; Barlow, 2005).
In accordance with NEPA, there would be no significant impact to fin whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to fin whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site B USWTR may affect fin whales. Should Site B become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Sperm Whale – Site B**

Sperm whales may occur in the CHASN OPAREA (including the proposed site B USWTR) from the vicinity of the continental shelf break to beyond the eastern boundary of the OPAREA throughout the year (DoN, 2008n). Sperm whales are expected seaward of the shelf break in the proposed Site B USWTR.

There are so few sightings of sperm whales in the vicinity of the proposed Site B USWTR that the resulting density estimate is zero. No Level A or Level B exposures are expected for sperm whales at the proposed Site B USWTR.

Sperm whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007). The anatomy of the sperm whale’s inner and middle ear indicates an ability to best hear high frequency to ultrasonic frequency sounds. Sperm whales may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The ABR technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz, with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001). The intersection of common frequencies between sperm whale functional hearing and mid- and high frequency sonars suggests that more often than not there is a potential for a behavioral response. There is some likelihood that low frequency vocalizations and sound dependent behaviors may not be disrupted or may only be partially disrupted or masked because the sperm whale has a functional hearing range lower than mid-frequency active sonars.

The current combined best estimate of sperm whale abundance from Florida to the Bay of Fundy in the western North Atlantic Ocean is 4,804 individuals (Waring et al., 2008). Stock structure for sperm whales in the North Atlantic is unknown (Dufault et al., 1999).

Lookouts would likely detect a group of sperm whales at the surface because they have a high likelihood of detection (0.87 in Beaufort Sea States of 6 or less; Barlow, 2005) given their large size (up to 17 m [56 ft]) (Leatherwood and Reeves, 1982), pronounced blow (large and angled), and mean group size (approximately seven animals). However, as a deep diving species, sperm whales can stay submerged, and therefore visually undetectable, for over an hour.
In accordance with NEPA, there would be no significant impact to sperm whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to sperm whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site B USWTR may affect on sperm whales. Should Site B become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

4.3.8.3 Site C

Five ESA-listed marine mammals may be present in the CHPT OPAREA. These are the North Atlantic right whale, humpback whale, sei whale, fin whale, and sperm whale. Blue whales are not expected to be present at the proposed Site C USWTR. There are so few sightings of North Atlantic right, humpback, sei, fin, and sperm whales in the vicinity of the proposed Site C USWTR that the resulting density estimates are zero. However, any of these species may occur in the proposed Site C USWTR. Should this location be selected as the Navy’s preferred alternative, the Navy would initiate ESA Section 7 consultation to reach concurrence with the NMFS on the degree of potential effects.

North Atlantic Right Whale – Site C

North Atlantic right whale occurrence in the CHPT OPAREA is between October through April, with peak sightings in February and March (Knowlton et al., 2002). During the summer months, right whales should occur farther north on their feeding grounds; however, there is one reported sighting in the summer in the CHPT OPAREA (DoN, 2008l). The North Atlantic right whale is expected to occur in the vicinity of the proposed Site C USWTR and may occur at any time of the year.

No Level A exposures are expected for North Atlantic right whales at the proposed Site C USWTR. Acoustic analysis indicates that up to three North Atlantic right whales may be exposed to levels of sound likely to result in Level B harassment (Table 4.3-10).

In terms of functional hearing capability, right whales belong to low frequency cetaceans which have best hearing ranging from 7Hz to 22 kHz. Right whale functional hearing overlaps with the frequencies produced by mid-frequency and high frequency active sonars. However, right whales apparently do not hear some low frequencies well. Right whale hearing capability was estimated using a mathematical model which predicted a hearing range of 10 Hz to 22 kHz, and a functional hearing range of 15 Hz to 18 kHz (Parks et al. 2007). Nowacek et al. (2004) noted a response to short tones and down sweeps at 0.5 to 4.5 kHz, but not to vessel noise of 0.05 to 0.5 kHz. Frequencies of high frequency active sonar above the right whale upper functional hearing range of 18 kHz may not result in a behavioral reaction.
According to the North Atlantic right whale report card released annually by the North Atlantic Right Whale Consortium, approximately 393 individuals are thought to occur in the western North Atlantic (NARWC, 2007). The most recent NOAA SAR states that in a review of the photo-id recapture database for June 2006, 313 individually recognized whales were known to be alive during 2001 (Waring et al., 2008). This is considered the minimum population size.

Detection probabilities for a group of North Atlantic right whales at the surface range from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f, g).

In accordance with NEPA, there would be no significant impact to North Atlantic right whales in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to North Atlantic right whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site C USWTR may affect North Atlantic right whales. Should Site C become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

Humpback Whale – Site C

Available data for the CHPT OPAREA indicate that humpback whales are expected to occur inshore along the continental shelf, and may occasionally occur farther offshore during fall, winter, and spring months (DoN, 2008l). Acoustic analysis indicates that no Level A or B exposures are expected for humpback whales on the proposed Site C USWTR (Table 4.3-10).

In terms of functional hearing capability, humpback whales belong to low frequency cetaceans which have best hearing ranging from 7Hz to 22 kHz. Recent information on the songs of humpback whales suggests that their hearing may extend to frequencies of at least 24 kHz (Au et al., 2006). Filter-bank models of the humpback whale’s ear suggest that humpbacks are sensitive to frequencies between 30 Hz and 18 kHz, with best sensitivity between 700 Hz and 10 kHz (Helweg et al., 2000; Houser et al., 2001a). Exposure to high frequency active sonar that is above the functional hearing capability of humpback whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

An estimated 11,570 humpback whales occur in the entire North Atlantic (Stevick et al., 2003a). Humpback whales in the North Atlantic are thought to belong to five different stocks based on feeding locations (Katona and Beard, 1990; Waring et al., 2008): Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, and Iceland. There appears to be very little exchange between these separate feeding stocks (Katona and Beard, 1990). The best estimate of abundance for the Gulf of Maine Stock is 847 individuals (Waring et al., 2008) based on a 2006 aerial survey. During the winter, most of the North Atlantic population of humpback
whales is believed to migrate south to calving grounds in the West Indies region (Whitehead and Moore, 1982; T.D. Smith et al., 1999; Stevick et al., 2003). During this time individuals from the various feeding stocks mix through migration routes as well as on the feeding grounds. The mixing of multiple stocks through the migratory season suggests that exposures off the southeastern U.S. are likely spread across all of the North Atlantic populations. There are not sufficient data available to estimate the percentage of exposures to each stock.

Lookouts would likely detect humpback whales at the surface because of their large size (up to 16 m [53 ft]) (Leatherwood and Reeves, 1982) and pronounced vertical blow. Detection probabilities for a group of humpback whales at the surface have ranged from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f,g).

In accordance with NEPA, there would be no significant impact to humpback whales in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to humpback whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site C USWTR may affect humpback whales. Should Site C become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Sei Whale – Site C**

Sei whales are found predominantly in deep water (NMFS, 1998a). Sei whales may occur in the CHPT OPAREA during fall, winter, and spring. Sei whales are not expected to occur in the CHPT OPAREA during summer, since they should be on feeding grounds around the eastern Scotian Shelf or Grand Banks. Sei whales are expected in the deep water portions of proposed Site C USWTR during fall, winter, and spring.

There are so few sightings of sei whales in the vicinity of the proposed Site C USWTR that a density estimate could not be calculated. No Level A or Level B exposures are expected for sei whales in the proposed Site C USWTR.

In terms of functional hearing capability, sei whales belong to low frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific sei whale hearing ranges. Exposure to high frequency active sonar that is above the functional hearing capability of sei whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Atlantic is 207; however this is considered conservative due to uncertainties in population movements and structure (Waring et al., 2008).

Lookouts would likely detect sei whales at the surface because they have high likelihood of detection (0.90 in Beaufort Sea States of 6 or less; Barlow, 2005). In the Northeast OPAREA, Palka (2006) estimated detection probabilities ranging from 0.32 to 0.94. Sei whales generally form groups of three animals or more, have a pronounced vertical blow, and are large animals.

*In accordance with NEPA, there would be no significant impact to sei whales in territorial waters from acoustic effects related to the proposed Site C USWTR.* In accordance with EO 12114, there would be no significant harm to sei whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site C USWTR may affect sei whales. Should Site C become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Fin Whale – Site C**

Fin whales may occur in the CHPT OPAREA (including the proposed Site C USWTR) during the winter. During spring and fall, fin whales may occur just north of the OPAREA and could overlap the northern portion of the CHPT OPAREA (DoN, 2008l). In the summer months, fin whales are expected to be farther north on feeding grounds and are not likely to occur in the CHPT OPAREA (DoN, 2008l). Fin whales may occur in proposed Site C USWTR during fall, winter, and spring.

There are so few sightings of fin whales in the vicinity of the proposed Site C USWTR that the resulting density estimate is zero. No Level A or Level B exposures are expected for fin whales in the proposed Site C USWTR.

In terms of functional hearing capability, fin whales belong to the low frequency group, which have best hearing ranging from 7 Hz to 22 kHz (Southall et al., 2007). Fin whale calls generally cover the 10 to 15 Hz frequency band and are less than 1 second in duration (Sirovic, 2006). Exposure to high frequency active sonar that is above the functional hearing capability of fin whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

The NOAA SAR estimates that there are 2,269 individual fin whales in the U.S. Atlantic waters (Waring et al., 2008); this is probably an underestimate, however, as survey coverage of known and potential fin whale habitat is incomplete.
Lookouts would likely detect a group of fin whales at the surface because they have a high likelihood of detection (0.90 in Beaufort Sea States of 6 or less; Barlow, 2005).

In accordance with NEPA, there would be no significant impact to fin whales in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to fin whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site C USWTR may affect fin whales. Should Site C become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Sperm Whale – Site C**

Sperm whales are expected to occur in waters seaward of the continental shelf edge (200-m [660-ft] isobath) throughout the year in the CHPT OPAREA (including the proposed Site C USWTR) (DoN, 2008).

There are so few sightings of sperm whales in the vicinity of the proposed Site C USWTR that the resulting density estimate is zero. No Level A or Level B exposures are expected for sperm whales in the proposed Site C USWTR.

Sperm whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007). The anatomy of the sperm whale’s inner and middle ear indicates an ability to best hear high frequency to ultrasonic frequency sounds. Sperm whales may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The ABR technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz, with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001). The intersection of common frequencies between sperm whale functional hearing and mid- and high frequency sonars suggests that more often than not there is a potential for a behavioral response. There is some likelihood that low frequency vocalizations and sound dependent behaviors may not be disrupted or may only be partially disrupted or masked because the sperm whale has a functional hearing range lower than mid-frequency active sonars.

The current combined best estimate of sperm whale abundance from Florida to the Bay of Fundy in the western North Atlantic Ocean is 4,804 individuals (Waring et al., 2008). Stock structure for sperm whales in the North Atlantic is unknown (Dufault et al., 1999).

Lookouts would likely detect a group of sperm whales at the surface because they have a high likelihood of detection (0.87 in Beaufort Sea States of 6 or less; Barlow, 2005) given their large size (up to 17 m [56 ft]) (Leatherwood and Reeves, 1982), pronounced blow (large and angled), and mean group size (approximately seven animals). However, as a deep diving species, sperm whales can stay submerged, and therefore visually undetectable, for over an hour.
In accordance with NEPA, there would be no significant impact to sperm whales in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to sperm whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site C USWTR would have no effect on sperm whales. Should Site C become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

4.3.8.4 Site D

Five ESA-listed marine mammal species may be present in the vicinity of the VACAPES OPAREA. These are the North Atlantic right whale, humpback whale, sei whale, fin whale, and sperm whale. Blue whales are not expected to be present at the proposed Site D USWTR. There are so few sightings of humpback, fin, sei, and sperm whales that the resulting density estimates are zero. However, these species may still occur in the proposed Site D.

North Atlantic Right Whale – Site D

Seasonal occurrence for North Atlantic right whales off the Virginia coast is between October and April, when these animals transit the area on their migrations to and from calving grounds farther south or feeding grounds farther north. North Atlantic right whales mainly occur in the coastal waters while migrating through the VACAPES OPAREA. Knowlton et al. (2002) report that sightings near the Chesapeake Bay occur primarily in October through December and February through March, with slight peaks in November, December, and March. North Atlantic right whales may occur in the VACAPES OPAREA during all seasons (DoN, 2008m). The North Atlantic right whale may occur in the proposed Site D USWTR at any time of the year.

Acoustic analysis indicates no Level A exposures and up to 16 Level B exposure to North Atlantic right whales annually on the proposed Site B USWTR (Table 4.3-11). This is considered an overestimate of predicted right whale sound exposure. The OPAREA density estimates as applied to the USWTR location are an overestimate. This is because the sample size of North Atlantic right whales was too small to estimate density from survey effort. Therefore, the density estimates were extrapolated from those developed for the fin whale, a comparable species (based on taxonomic class, general group size, general distribution, and general behavior characteristics) for which there are available line transect data (DoN, 2002a). The density estimate for fin whales in the on-shelf VACAPES OPAREA depth regimes was scaled by the ratio of fin whale sightings to right whale sightings across the entire shelf. Thus, a uniform ratio of fin whales to right whales was assumed across the entire shelf region of the VACAPES OPAREA. However, the current literature states with confidence that right whale occurrence is not uniform across the shelf. Specifically, Knowlton et al. (2002) report that 94% of all sightings and 80% of all tagged animals occurred within 55 km (30 NM) of land. Additionally, 93% of sightings are in waters no
deeper than 25 fm (approximately 47 m) and 80.5% of tagged animals (excluding the northernmost segment of the study range) are within 15 fm (approximately 27 m).

While it was once thought that the description of the nearshore migratory corridor was due to survey bias, Knowlton et al. (2002) report that extensive offshore effort shows that sightings of animals far offshore are rare. Fin whales do not share this pattern of a distinct nearshore migratory corridor. Therefore, migrating right whales are generally expected to be inshore of the proposed USWTR location (the western edge of which is approximately 63 km [34 NM] from shore), and the use of a uniform ratio of right whales to fin whales in development of the density estimates used in the acoustic model overestimates the likelihood of effect in comparison to actual spatial distribution of the right whale.

Although there are no studies evaluating acoustic disturbance of migrating right whales, Richardson (1999) studied reactions of bowhead whales to seismic surveys during their autumn migration. While bowheads avoided the area within 20 km (10.8 NM) of operating airguns, they were common in the same location on days surveys were not underway. Because of the similarity between right whales and bowheads, it may be inferred that even in the unlikely event a right whale was present and momentarily disturbed by active acoustics, it would not exhibit long-term displacement in the area of the range, nor would the overall migratory pattern be significantly affected.

In terms of functional hearing capability, right whales belong to low-frequency cetaceans which have best hearing ranging from 7Hz to 22 kHz. Right whale functional hearing overlaps with the frequencies produced by mid-frequency and high frequency active sonars. However, right whales apparently do not hear some low frequencies well. Right whale hearing capability was estimated using a mathematical model which predicted a hearing range of 10 Hz to 22 kHz, and a functional hearing range of 15 Hz to 18 kHz (Parks et al. 2007). Nowacek et al. (2004) noted a response to short tones and down sweeps at 0.5 to 4.5 kHz, but not to vessel noise of 0.05 to 0.5 kHz. Frequencies of high-frequency active sonar above the right whale upper functional hearing range of 18 kHz may not result in a behavioral reaction.

According to the North Atlantic right whale report card released annually by the North Atlantic Right Whale Consortium, approximately 393 individuals are thought to occur in the western North Atlantic (NARWC, 2007). The most recent NOAA SAR states that in a review of the photo-id recapture database for June 2006, 313 individually recognized whales were known to be alive during 2001 (Waring et al., 2008). This is considered the minimum population size.

Detection probabilities for a group of North Atlantic right whales at the surface range from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f,g).

Based on best available science, the Navy concludes that exposures to North Atlantic right whales on the proposed Site D USWTR would result in short-term effects if an individual is exposed and would likely not affect annual rates of recruitment or survival. The mitigations
presented in Chapter 6 would further reduce the potential for exposures to occur to North Atlantic right whales.

_In accordance with NEPA, there would be no significant impact to North Atlantic right whales in territorial waters from acoustic effects related to the proposed Site D USWTR._ In accordance with EO 12114, there would be no significant harm to North Atlantic right whales in non-territorial waters from acoustic effects on the proposed Site D USWTR.

In accordance with the ESA, the Navy finds that activities on the proposed Site D USWTR may affect North Atlantic right whales. Should Site D become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Humpback Whale – Site D**

Available data indicate that humpback whales are distributed in nearshore and continental shelf waters of the VACAPES OPAREA, as well as open ocean waters on and outside of the shelf edge (200-m [660-ft] isobath). The majority of offshore sightings occurs in the spring and fall when humpback whales are migrating between calving and feeding grounds. Humpbacks are presumed to make their migrations in a direct route through deep offshore waters (T.D. Smith et al., 1999). The acoustic modeling results show that the proposed action may affect one humpback whale per year without creating a likelihood of injury (Appendix D). The humpback whale is expected to occur in the proposed Site D USWTR during the fall, winter, and spring. In the summer, they are expected to be farther north on their feeding grounds.

Acoustic analysis indicated that no Level A or Level B exposures are expected for humpback whales in the proposed Site D USWTR (Table 4.3-11).

In terms of functional hearing capability humpback whales belong to low-frequency cetaceans which have best hearing ranging from 7Hz to 22 kHz. Recent information on the songs of humpback whales suggests that their hearing may extend to frequencies of at least 24 kHz (Au et al., 2006). Filter-bank models of the humpback whale’s ear suggest that humpbacks are sensitive to frequencies between 30 Hz and 18 kHz, with best sensitivity between 700 Hz and 10 kHz (Helweg et al., 2000; Houser et al., 2001a). Exposure to high frequency active sonar that is above the functional hearing capability of humpback whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

An estimated 11,570 humpback whales occur in the entire North Atlantic (Stevick et al., 2003a). Humpback whales in the North Atlantic are thought to belong to five different stocks based on feeding locations (Katona and Beard, 1990; Waring et al., 2008): Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, and Iceland. There appears to be very little exchange between these separate feeding stocks (Katona and Beard, 1990). The best
estimate of abundance for the Gulf of Maine Stock is 847 individuals (Waring et al., 2008) based on a 2006 aerial survey. During the winter, most of the North Atlantic population of humpback whales is believed to migrate south to calving grounds in the West Indies region (Whitehead and Moore, 1982; T.D. Smith et al., 1999; Stevick et al., 2003). During this time individuals from the various feeding stocks mix through migration routes as well as on the feeding grounds. The mixing of multiple stocks through the migratory season suggests that exposures off the southeastern U.S. are likely spread across all of the North Atlantic populations. There are not sufficient data available to estimate the percentage of exposures to each stock.

Lookouts would likely detect humpback whales at the surface because of their large size (up to 16 m [53 ft]) (Leatherwood and Reeves, 1982) and pronounced vertical blow. Detection probabilities for a group of humpback whales at the surface have ranged from 0.19 to 1.0 for aerial and shipboard surveys in the Atlantic and Pacific (DoN, 2007e,f, g).

In accordance with NEPA, there would be no significant impact to humpback whales in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to humpback whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site D USWTR may affect humpback whales. Should Site D become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Sei Whale – Site D**

Sei whales may occur throughout the VACAPES OPAREA year-round. During the summer, sei whales are generally farther north on feeding grounds around the eastern Scotian Shelf or Grand Banks; however, sightings within the OPAREA during this time of year may represent individuals making early or late migrations to the feeding grounds (DoN, 2008m). The sei whale may occur in the proposed Site D USWTR at any time of year.

There are so few sightings of sei whales in the vicinity of the proposed Site D USWTR that a density estimate could not be calculated. No Level A or Level B exposures are expected for sei whales in the proposed Site D USWTR.

In terms of functional hearing capability, sei whales belong to low-frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific sei whale hearing ranges. Exposure to high frequency active sonar that is above the functional hearing capability of sei whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.
The IWC recognizes three sei whale stocks in the North Atlantic: Nova Scotia, Iceland-Denmark Strait, and Northeast Atlantic (Perry et al., 1999). The Nova Scotia stock occurs in U.S. Atlantic waters (Waring et al., 2008). The best abundance estimate for sei whales in the western North Atlantic is 207; however, this is considered conservative due to uncertainties in population movements and structure (Waring et al., 2008).

Lookouts would likely detect sei whales at the surface because they have high likelihood of detection (0.90 in Beaufort Sea States of 6 or less; Barlow, 2005). In the Northeast OPAREA, Palka (2006) estimated detection probabilities ranging from 0.32 to 0.94. Sei whales generally form groups of three animals or more, have a pronounced vertical blow, and are large animals.

*In accordance with NEPA, there would be no significant impact to sei whales in territorial waters from acoustic effects related to the proposed Site D USWTR.* In accordance with EO 12114, there would be no significant harm to sei whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site D USWTR may affect sei whales. Should Site D become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Fin Whale – Site D**

Fin whales are expected to occur in the VACAPES OPAREA year round (DoN, 2008m). Sighting data indicate that there is a seasonal nature to the distribution of fin whales in this area. Fin whales are likely to be more concentrated in the vicinity of the proposed Site D USWTR in the spring and summer months, but may occur there at any time of the year.

Acoustic modeling predicts that activities on the proposed Site D USWTR could result in Level B (behavioral) harassment of up to 87 fin whales annually (Table 4.3-11). The exposure estimate represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. Acoustic analysis indicates that no fin whales would be exposed to sound levels likely to result in Level A harassment.

In terms of functional hearing capability, fin whales belong to the low frequency group, which have best hearing ranging from 7 Hz to 22 kHz (Southall et al., 2007). Fin whale calls generally cover the 10 to 15 Hz frequency band and are less than 1 second in duration (Sirovic, 2006). Exposure to high frequency active sonar that is above the functional hearing capability of fin whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.
The NOAA SAR estimates that there are 2,269 individual fin whales in the U.S. Atlantic waters (Waring et al., 2008). This is probably an underestimate, however, as survey coverage of known and potential fin whale habitat is incomplete.

Lookouts would likely detect a group of fin whales at the surface because they have a high likelihood of detection (0.90 in Beaufort Sea States of 6 or less; Barlow, 2005).

*In accordance with NEPA, there would be no significant impact to fin whales in territorial waters from acoustic effects related to the proposed Site D USWTR.* In accordance with EO 12114, there would be no significant harm to fin whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site D USWTR may affect fin whales. Should Site D become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

**Sperm Whale – Site D**

In the VACAPES OPAREA, sperm whales are distributed along the continental shelf edge and over the continental slope (DoN, 2008m). There have also been occasional sightings on the continental shelf. Sperm whales may occur throughout the slope and deep waters of the OPAREA (DoN 2008m). The sperm whale is expected to occur in the proposed Site D USWTR year round.

The acoustic modeling results show that the proposed action may affect 16269 sperm whales per year without creating a likelihood of injury (Table 4.3-11).

Sperm whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007). The anatomy of the sperm whale’s inner and middle ear indicates an ability to best hear high frequency to ultrasonic frequency sounds. Sperm whales may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The ABR technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz, with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder, 2001). The intersection of common frequencies between sperm whale functional hearing and mid- and high frequency sonars suggests that more often than not there is a potential for a behavioral response. There is some likelihood that low frequency vocalizations and sound dependent behaviors may not be disrupted or may only be partially disrupted or masked because the sperm whale has a functional hearing range lower than mid-frequency active sonars.

The current combined best estimate of sperm whale abundance from Florida to the Bay of Fundy in the western North Atlantic Ocean is 4,804 individuals (Waring et al., 2008). Stock structure for sperm whales in the North Atlantic is unknown (Dufault et al., 1999).
Lookouts would likely detect a group of sperm whales at the surface because they have a high likelihood of detection (0.87 in Beaufort Sea States of 6 or less; Barlow, 2005) given their large size (up to 17 m [56 ft]) (Leatherwood and Reeves, 1982), pronounced blow (large and angled), and mean group size (approximately seven animals). However, as a deep diving species, sperm whales can stay submerged, and therefore visually undetectable, for over an hour.

*In accordance with NEPA, there would be no significant impact to sperm whales in territorial waters from acoustic effects related to the proposed Site D USWTR.* In accordance with EO 12114, there would be no significant harm to sperm whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

In accordance with the ESA, the Navy finds the activities on the proposed Site D USWTR may affect sperm whales. Should Site D become the Navy’s preferred alternative, a consultation with the NMFS would be initiated in accordance with Section 7 of the ESA for concurrence.

### 4.3.9 Marine Mammal Protection Act: Estimated Harassment of Non-ESA-Listed Marine Mammals

The process for establishing criteria and thresholds for assessing the effect of sound on marine mammals was presented in Subchapter 4.3.3. The application of the thresholds to establish sound exposure zones for the purpose of the acoustic model was described in Subchapter 4.3.2. The subsequent use of these zones to estimate the potential for incidental harassment of marine mammals is described in this subchapter. As previously discussed, exposure to sound levels predicted to result in TTS and behavioral effects at levels below TTS may not result in abandonment or significant alteration of natural behavioral patterns (the military readiness standard for Level B harassment). However, all exposures exceeding the thresholds predicted to induce TTS or behavioral disruption are conservatively considered as Level B harassment for this OEIS/EIS.

A two-step process was used to estimate harassment under the MMPA.

- First, as described in Subchapter 4.3.7, an acoustic model was run using density estimates for the JAX/CHASN, CHPT, and VACAPES OPAREAs (DoN, 2008l, m, n).

- Second, the analysis was focused on the smaller geographic areas that would actually be affected by operations on the proposed USWTR. As described in Subchapter 4.3.8, when interpreting the results of the acoustic effect modeling, it is important to understand whether there are any limitations to the ecological data used in the model, and, if so, to interpret the model results within the context of a given species’ ecology. Life history information and the distribution of species on the actual proposed USWTR sites, versus the larger OPAREA data that were
input to the acoustic model, were evaluated to verify that the model results accurately reflect expected species presence.

The resulting annual MMPA harassment estimates for the proposed USWTR locations are presented in Subchapter 4.3.8 in Table 4.3-8 for Site A, Table 4.3-9 for Site B, and Table 4.3-10 for Site C, and Table 4.3-11 for Site D. The determination of whether an incidental take statement (ITS) and MMPA authorization would be required for ESA-listed marine species will be made as part of the ongoing consultation with the NMFS. ESA-listed marine mammals are, therefore, not additionally addressed in this subchapter, as those acoustic exposure estimates were presented in Subchapter 4.3.8.

The analyses provided below present an estimate of incidental harassment for each species, and describe these estimates in the context of the overall species’ population or stock. Overall, the conclusions in this subchapter find that impacts to marine mammals would be negligible for each of the proposed alternatives for the following reasons:

- The overwhelming majority of the acoustic exposures are within the non-injurious TTS or behavioral effects zones.
  - Mitigation measures as presented in Chapter 6 would prevent the few exposures to sound levels causing PTS/injury (Level A harassment) that are expected to occur based upon the acoustic exposure estimates. See the Sites A and C discussions of bottlenose and Atlantic spotted dolphins, and the Site D discussions of striped and common dolphins for further explanation of this finding relative to the Level A exposure predicted via the acoustic model.
  - Although the Level B columns of Tables 4.3-8 through 4.3-11 represent estimated harassment incidents under the MMPA, as described above, they are conservative estimates of harassment by behavioral disturbance, and are not indicative of a likelihood of either injury or harm.
  - Additionally, the mitigation measures described in Chapter 6 are designed to reduce sound exposure of marine mammals to levels below those that may cause “behavioral disruptions.” These measures will be discussed with the NMFS during the MMPA take authorization process.

- Consideration of negligible impact is required for the NMFS to authorize incidental harassment of marine mammals. By definition, an activity has a “negligible impact” on a species or stock when it is determined that the total taking is not likely to reduce annual rates of adult survival or annual recruitment (i.e., offspring survival, birth rates). Based on each species’ life history information, the expected behavioral patterns in the USWTR locations, and consideration of the estimated behavioral disturbance levels, an analysis of the
potential effects of the proposed action on species recruitment or survival is presented for each species. These species-specific analyses support the conclusion that proposed USWTR installation and operations would have a negligible impact on marine mammals at any of the proposed USWTR alternative sites.

The Navy will submit an MMPA LOA request and work through that process to discuss the mitigation measures presented in Chapter 6 and their potential to reduce the likelihood for behavioral disturbance and incidental harassment of marine mammals. The model results and the estimates of harassment primarily without consideration of mitigation are presented below.

### 4.3.9.1 Site A

The following subchapter presents the marine mammal incidental harassment estimates for the proposed Site A USWTR. Only species predicted to experience one or more incidents of harassment are presented here, and these numbers reflect the species, numbers, and type of harassment for which an MMPA LOA will be requested. Note that ESA-listed species are not included on these tables, as information on these species was presented for each USWTR alternative in Subchapter 4.3.8.

Information on the species population and/or stock is provided for each species. The text also describes the rationale behind any differences between the Appendix D raw acoustic impact model outputs and Table 4.3-8. The population estimates for each species were taken from the NMFS stock assessments reports for 2007 (Waring et al., 2008).

**Minke Whale – Site A**

Minke whales generally occupy the continental shelf and are widely scattered in the mid-Atlantic region (CETAP, 1982). Minke whale sightings have been recorded in the vicinity of the proposed Site A USWTR during the winter (DoN, 2008n). The winter range of some rorquals (and often extrapolated to the minke whale) is thought to be in deep, offshore waters particularly at lower latitudes (Kellogg, 1928; Gaskin, 1982), and minke whale sightings have been reported in deep waters during this time of year (Slijper et al., 1964; Mitchell, 1991). In the JAX OPAREA, minke whales may occur just inshore of the shelf break and seaward throughout most of the year (DoN, 2008n). The minke whale is expected to occur in the Site A USWTR, except during the summer, when minke whales are expected to occur at higher latitudes on their feeding grounds. The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring et al., 2008).

The harassment analysis results show that no Level A harassment of minke whales would occur. The modeling shows that up to seven incidental exposures of minke whales to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-8). These exposures would not necessarily occur to seven different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual minke
whales experiencing Level B harassment may be fewer than seven. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on minke whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for minke whales and would have a negligible impact on this species.

In terms of functional hearing capability minke whales belong to low-frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific minke whale hearing ranges. Exposure to high-frequency active sonar that is above the functional hearing capability of minke whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Due to the conspicuousness of this species at the surface, lookouts would likely detect a group of minke whales at the surface given their large size (up to 8 m [27 ft]), pronounced blow, and breaching behavior (Barlow, 2005).

In accordance with NEPA, there would be no significant impact to minke whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to minke whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Pygmy and Dwarf Sperm Whales – Site A**

In the North Atlantic, pygmy and dwarf sperm whales generally occur along the shelf-edge and deeper, in warm-temperate to tropical waters (DoN, 2009g). This species may occur in the JAX OPAREA from the vicinity of the continental shelf break to beyond the eastern boundary of the OPAREA, including the proposed Site A USWTR. Occurrence is expected to be the same for all seasons (DoN, 2008n). Pygmy and dwarf sperm whales are difficult to distinguish and are often collectively referred to as *Kogia* spp. *Kogia* spp. occurring in the proposed Site A USWTR would be from the western North Atlantic stock. The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring et al., 2008).

The analysis results show that no Level A harassment of *Kogia* spp. and up to three incidents of behavioral disruption (Level B harassment) could occur annually. These exposures would not necessarily occur to three different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pygmy or dwarf sperm whales experiencing Level B harassment may be fewer than three. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on pygmy or dwarf sperm whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for pygmy or dwarf sperm whales and would have a negligible impact on these species.
In terms of functional hearing capability pygmy and dwarf sperm whales belong to high-frequency cetaceans which have best hearing ranging from 200 Hz to 180 kHz. No information on hearing is available for the dwarf sperm whale. An ABR study completed on a stranded pygmy sperm whale indicated a hearing range of 90 to 150 kHz (Ridgway and Carder, 2001). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of pygmy or dwarf sperm whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts may not readily sight pygmy and dwarf sperm whales. Because pygmy and dwarf sperm whales are cryptic (difficult to detect at the surface) and deep diving, they have a relatively low detection probability, estimated by Barlow and Forney (2006) at 0.35. It is possible that modeled exposures resulting in behavioral disruption may be realized. Even though the pygmy and dwarf sperm whales may exhibit a reaction when initially exposed to active acoustic energy, the exposures are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures.

In accordance with NEPA, there would be no significant impact to pygmy or dwarf sperm whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to pygmy and dwarf sperm whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

Beaked Whales – Site A

Cuvier’s, True’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species that may occur in the JAX OPAREA, with possible extralimital occurrences of the Sowerby’s beaked whale. Beaked whale abundance off the U.S. Atlantic Coast may be highest in association with the Gulf Stream and the warm-core rings it develops (Waring et al., 1992). Beaked whales may occur seaward of the shelf break throughout the JAX OPAREA (DoN, 2008n). Expected beaked whale occurrence is seaward of the shelf break year-round in the Site A USWTR. Beaked whale sightings in the western North Atlantic Ocean appear to be concentrated in waters between the 200-m (656-ft) isobath and those just beyond the 2,000-m (6,560-ft) isobath (DoN, 2008l, m). The best estimate of *Mesoplodon* spp. and Cuvier’s beaked whale abundance combined in the western North Atlantic is 3,513 individuals (Waring et al., 2008).

The acoustic analysis indicates that up to 28 incidental exposures of beaked whales to sound levels that could cause behavioral disruption (Level B harassment) may occur on an annual basis (Table 4.3-8). These exposures would not necessarily occur to 28 different individuals. The same beaked whale could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual beaked whales experiencing harassment may be fewer than 28.
Beaked whales’ functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007) though best hearing is presumed to occur at ultrasonic frequencies (MacLeod, 1999; DoN, 2000b). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod, 1999; DoN, 2000b). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais’ beaked whale using auditory evoked potential techniques (Cook et al., 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al., 2006). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

In accordance with NEPA, there would be no significant impact to beaked whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to beaked whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Rough-Toothed Dolphin – Site A**

The rough-toothed dolphin is regarded as an offshore species that prefers deep waters; however, it can occur in waters with variable bottom depths (e.g., Gannier and West, 2005). Rough-toothed dolphins may occur seaward of the shelf break in the JAX OPAREA year-round. The rough-toothed dolphin is expected seaward of the shelf break on the proposed Site A USWTR. There is no information on stock structure for rough-toothed dolphins in the North Atlantic. No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring et al., 2008).

The analysis results show that no Level A harassment and up to 78 incidents of behavioral disruption (Level B harassment) of rough-toothed dolphins could occur annually (Table 4.3-8). Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on rough-toothed dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for rough-toothed dolphins and would have a negligible impact on these species.

Functional hearing for rough-toothed dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Scientists have determined the rough-toothed dolphin can detect sounds between 5 and 80 kHz and probably much higher (Cook et al., 2005). The echolocation frequency range (0.1 to 200 kHz) of this species has some overlap with mid-frequency active and high-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of rough-toothed dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal.
If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts would likely detect a group of rough-toothed dolphins at the surface because of rough-toothed dolphins’ high probability of detection (0.76 in Beaufort sea states of 6 or less; Barlow, 2006). Implementation of mitigation measures and probability of detecting large groups of rough-toothed dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to rough-toothed dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR.* In accordance with EO 12114, there would be no significant harm to rough-toothed dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Bottlenose Dolphin – Site A**

The sighting data reflect that bottlenose dolphins are distributed mainly along the coast, across the continental shelf, over the continental shelf break, and in waters over the continental slope to the 4,000-m (13,120-ft) isobath. Bottlenose dolphin occurrence in the JAX OPAREA is expected to be the same throughout the year. There is a concentrated occurrence of these dolphins from the coast to outside the continental shelf break over the upper continental slope. There is a low or unknown occurrence of bottlenose dolphins in waters with a bottom depth greater than 4,000 m (13,120 ft) (DoN, 2008n). Bottlenose dolphins occurring on the proposed Site A USWTR would be from the western North Atlantic offshore stock. Currently, a single western North Atlantic offshore stock is recognized seaward of 34 km (18NM) from the U.S. coastline (Waring et al., 2008). While individuals from one or more of the coastal stocks may occasionally occur on or near the range, available data and information (e.g. Garrison et al., 2003; Torres et al., 2003; Waring et al., 2008) suggest the majority of bottlenose dolphins occurring on the proposed Site A USWTR would be from the western North Atlantic offshore stock. The current best population estimate for the offshore stock is 81,588 individuals (Waring et al., 2008).

The analysis results show that four Level A harassments of bottlenose dolphins and up to 50,504 incidents of behavioral disruption (Level B harassment) would occur annually (Table 4.3-8). Mitigation measures as presented in Chapter 6 would prevent the few exposures to sound levels causing PTS/injury (Level A harassment) that are expected to occur based upon the acoustic exposure estimates. These exposures would not necessarily occur to 50,504 different individuals. The same bottlenose dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual bottlenose dolphins experiencing Level B harassment may be fewer than 50,504. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for all bottlenose dolphins and would have a negligible impact on this species.
Functional hearing for bottlenose dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007) with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Bottlenose dolphins communicate via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Signature whistles, which identify individual dolphins and are a dominant characteristic of communications between mothers and calves, range from 3.4 to 14.5 kHz, comparable to the 1 to 10 kHz range of mid-frequency active sonar. Potential Level B exposures from mid-frequency active sonar could therefore result in impaired communication between mother and calf pairs. In addition, experiments support the likelihood that some high-frequency active sonar frequencies could result in a behavioral response. Observed changes in behavior in one bottlenose dolphin were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 µPa (DoN, 1997b; Schlundt et al., 2000). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of bottlenose dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

In accordance with NEPA, there would be no significant impact to bottlenose dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to bottlenose dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Pantropical and Atlantic Spotted Dolphins – Site A**

Both the pantropical and Atlantic spotted dolphins are expected to occur from the coastline to seaward of the eastern boundary of the JAX OPAREA throughout the year. The pantropical spotted dolphin is a deep-water species, and the Atlantic spotted dolphin may occur in both shelf and offshore waters (DoN, 2009g). Sightings of spotted dolphins in coastal waters are most likely of the Atlantic spotted dolphin. Either species could occur at the proposed USWTR. Spotted dolphins occurring on the proposed Site B USWTR would be from the western North Atlantic stocks. In the western North Atlantic, the best abundance estimate for pantropical spotted dolphins is 4,439; for Atlantic spotted dolphins, it is 50,978 (Waring et al., 2008).

The acoustic analysis estimates three incidents of Level A harassment of spotted dolphins annually. The mitigation measures detailed in Chapter 6 would eliminate this low probability of injurious effect on spotted dolphins; therefore, no Level A incidental harassment is anticipated for spotted dolphins.

The acoustic model estimates that up to 51,011 incidents of behavioral disruption (Level B harassment) to spotted dolphins (3,645 pantropical and 47,366 Atlantic) would occur annually. These exposures would not necessarily occur to 51,011 different individuals. The same spotted dolphin could be exposed multiple times over the course of a year, particularly if the animal is
resident in the area of the range. Thus, the estimated number of individual spotted dolphins experiencing Level B harassment may be less than 51,011. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for either species of spotted dolphin, and impacts to the species would be negligible.

Functional hearing for pantropical spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Pantropical spotted dolphins communicate, feed and socialize via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995) which overlaps well with mid-frequency active sonar, while clicks are bimodal with peaks at 40 to 60 kHz and 120 to 140 kHz and more aligned with high frequency sonar (Schotten et al., 2004). Potential Level B exposures from mid-frequency active and high frequency sonar could therefore result in impaired communication, changes in foraging and social interaction. However, any behavioral responses are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.

Functional hearing for Atlantic spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Atlantic spotted dolphins produce a variety of sounds in frequencies from .1 to above 100 kHz. Whistles range from 7.1 to 14.5 kHz which overlaps with mid-frequency active sonar (1 to 10 kHz) while echolocation clicks ranging from 40 to 130 kHz overlap well with high frequency sonar. Some communication does occur at frequencies below that for mid-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of Atlantic spotted dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Given their frequent surfacing, large group size encompassing hundreds of animals (Leatherwood and Reeves, 1982) and probability of trackline detection of 1.00 in Beaufort sea states of 6 or less (Barlow, 2006), lookouts would likely detect both Atlantic and pantropical spotted dolphins at the surface. Implementation of mitigation measures and probability of detection reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Atlantic and pantropical spotted dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to Atlantic and
pantropical spotted dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Striped Dolphin – Site A**

Striped dolphins are distributed worldwide in cool-temperate to tropical zones. Based on sparse available data, striped dolphins may occur sporadically near and seaward of the shelf break throughout the JAX OPAREA year-round. Striped dolphins may occur rarely in the vicinity of the shelf break within the proposed Site A USWTR. The best estimate of striped dolphin abundance in the western North Atlantic is 94,462 individuals (Waring et al., 2008).

The acoustic model indicates that no striped dolphins will be exposed to acoustic levels likely to result in Level A or Level B harassment (Table 4.3-8).

Functional hearing for striped dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Kastelein et al., (2003) determined the hearing sensitivity of a single striped dolphin to range from 0.5 to 160 kHz with best sensitivity at 64 kHz. Assuming this study may be applicable to striped dolphins in general, the frequency of best sensitivity for this species is much higher than the range of frequencies for mid-frequency active sonar but aligns well with that of high-frequency active sonar. Dominant frequencies of whistles ranged from 8 to 12.5 kHz (Thomson and Richardson, 1995).

Given their gregarious behavior and large group size of up to several hundred or even thousands of animals (Baird et al., 1993), it is likely that lookouts would detect a group of striped dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of striped dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to striped dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR.* In accordance with EO 12114, there would be no significant harm to striped dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Clymene Dolphin – Site A**

Clymene dolphins are expected in waters seaward of the shelf break in the JAX OPAREA (including the proposed Site A USWTR) throughout the year. Clymene dolphins occurring on the proposed Site A USWTR would be from the western North Atlantic stock. The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring et al., 2008).

The modeling effort and harassment analyses estimate no Level A harassment of Clymene dolphins. The analysis estimates that up to 1,741 incidental exposures of a Clymene dolphin to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-8). These exposures would not necessarily occur to 1,741 different individuals. The
same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Clymene dolphins experiencing Level B harassment may be fewer than 1,741. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on Clymene dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for Clymene dolphins, and would have a negligible impact on this species.

Functional hearing for Clymene dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in frequency (range of 6.3 to 19.2 kHz). This frequency range has some overlap with mid-frequency active sonar and aligns well with the lower end of the high-frequency active frequency range.

Given their gregarious behavior and potentially large group size of up to several hundred or even thousands of animals (Jefferson, 2006), it is likely that lookouts would detect a group of Clymene dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Clymene dolphins reduce the likelihood of exposure.

_In accordance with NEPA, there would be no significant impact to Clymene dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR._ In accordance with EO 12114, there would be no significant harm to Clymene dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Common Dolphin – Site A**

Although the common dolphin is often found along the shelf-edge, there are sighting and bycatch records in shallower waters to the north, as well as sightings on the continental shelf in the JAX OPAREA (DoN, 2008n). Based on the cool water temperature preferences of this species and available sighting data, there is likely a very low possibility of encountering common dolphins during the winter, spring, and fall throughout the JAX OPAREA (DoN, 2008n). Common dolphins may occur in the Site A USWTR during this time of year. While there are a number of historical stranding records for common dolphins during the summer, there have been no recent confirmed records for this species. Therefore, common dolphins are not expected to occur in the Site A USWTR during the summer. The best estimate of abundance for the Western North Atlantic _Delphinus_ spp. stock is 120,743 individuals (Waring et al., 2008).

The acoustic model indicates that no common dolphins will be exposed to acoustic levels likely to result in Level A or Level B harassment (Table 4.3-8).

Functional hearing for common dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). This species’ hearing range extends from 10 to 150 kHz with greatest sensitivity from 60 to 70 kHz (Popov
and Klishin, 1998). This species range of best hearing aligns well with high-frequency active sonar frequencies.

Given their gregarious behavior and large group size of up to thousands of animals (Jefferson et al. 1993), it is likely that lookouts would detect a group of common dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of common dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to common dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR.* In accordance with EO 12114, there would be no significant harm to common dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Risso’s Dolphin – Site A**

Risso’s dolphin is expected to occur year-round from the 50-m (164-ft) isobath to seaward of the eastern boundary of the JAX OPAREA (including the proposed Site A USWTR). Risso’s dolphins occurring on the proposed Site A USWTR would be from the western North Atlantic stock. The best estimate of Risso’s dolphin abundance in the western North Atlantic is 20,479 individuals (Waring et al., 2008).

The acoustic modeling results show that no Level A harassment of Risso’s dolphin would occur. The analysis results show that up to 2,583 incidental exposures of Risso’s dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-8). These exposures would not necessarily occur to 2,583 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Risso’s dolphins experiencing Level B harassment may be fewer than 2,583. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for Risso’s dolphins and would have a negligible impact on this species.

Functional hearing for Risso’s dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Nachtigall et al. (1995; 2005) measured hearing in an adult and an infant Risso’s dolphin. The adult hearing ranged from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. The infant could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz, well above mid-frequency active sonar frequencies but well within the high-frequency active sonar frequency range. The intersection of common frequencies between Risso’s dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.
Given the frequent surfacing behavior and large group size of Risso’s dolphins (Leatherwood and Reeves, 1982), it is likely that lookouts would detect a group of Risso’s dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Risso’s dolphins reduce the likelihood of exposure.

In accordance with NEPA, there will be no significant impact to Risso’s dolphins in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there will be no significant harm to Risso’s dolphins in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**Pilot Whales – Site A**

There are two species of pilot whales in the western Atlantic: the Atlantic, or long-finned, pilot whale and the short-finned pilot whale. These species are difficult to identify to the species level at sea; therefore, the descriptive material often refers to them collectively. Expected occurrence of pilot whales in the JAX OPAREA is from the vicinity of the continental shelf break into waters seaward of the OPAREA boundary, including the proposed Site A USWTR. There is a low or unknown occurrence of pilot whales between the shore and the vicinity of the continental shelf break for all seasons. This is based upon sightings of pilot whales on the continental shelf (including waters quite close to shore) to the north of the JAX OPAREA (DoN, 2008n). Pilot whales occurring in the proposed Site A USWTR would be from the western North Atlantic stocks. The best estimate of pilot whale abundance (combined short-finned and long-finned) in the western North Atlantic is 31,139 individuals (Waring et al., 2008).

The modeling results show that up to 1,834 incidental exposures of pilot whales to non-injurious levels of acoustic energy (Level B harassment) may occur on an annual basis (Table 4.3-8). These exposures would not necessarily occur to 1,834 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pilot whales experiencing Level B harassment may be fewer than 1,834. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on pilot whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for all pilot whales and would have a negligible impact on these species.

Functional hearing for pilot whales is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz. Communication frequencies for pilot whales therefore align well with both mid-frequency active and high-frequency active sonar frequencies. High-frequency active sonar frequencies above 60 kHz may or may not result in a response. If a pilot whale does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.
Pilot whale group size typically ranges from several to several hundred individuals (Jefferson et al., 1993). Given the large body size, gregarious behavior, and group size of pilot whales, it is likely that lookouts would detect a group of pilot whales at the surface. Implementation of mitigation measures and probability of detecting groups of pilot whales reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to pilot whales in territorial waters from acoustic effects related to the proposed Site A USWTR. In accordance with EO 12114, there would be no significant harm to pilot whales in non-territorial waters from acoustic effects related to the proposed Site A USWTR.

**4.3.9.2 Site B**

The following subchapter presents the marine mammal incidental harassment estimates for the proposed Site B USWTR. Only species predicted to experience one or more incidents of harassment are presented here, and these numbers reflect the species, numbers, and type of harassment for which a MMPA LOA would be requested if the Site B became the Navy’s preferred alternative. Note that ESA-listed species are not included on these tables, as information on these species was presented for each USWTR alternative in Subchapter 4.3.8.

Information on the species population and/or stock is provided for each species. The text also describes the rationale behind any differences between the Appendix D raw acoustic impact model outputs and Table 4.3-9. The population estimates for each species were taken from the NMFS stock assessments reports for 2007 (Waring et al., 2008).

**Minke Whale – Site B**

Spring and summer are periods of relatively widespread minke whale occurrence off the northeastern U.S. and winter is the only season that the minke whale may occur in the CHASN OPAREA, primarily in shelf and deep waters (DoN, 2008n). Minke whales are expected in the proposed Site B USWTR. The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring et al., 2008).

The harassment analysis results show that no Level A harassment of minke whales would occur. The modeling shows that up to one incidental exposure of minke whales to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-9). Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on minke whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for minke whales and would have a negligible impact on this species.

In terms of functional hearing capability minke whales belong to low-frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific minke whale hearing ranges. Exposure to high-frequency active sonar that is above the
functional hearing capability of minke whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Due to the conspicuousness of this species at the surface, lookouts would likely detect a group of minke whales at the surface given their large size (up to 8 m [27 ft]), pronounced blow, and breaching behavior (Barlow, 2005).

In accordance with NEPA, there would be no significant impact to minke whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to minke whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

**Pygmy and Dwarf Sperm Whales – Site B**

In the North Atlantic, pygmy and dwarf sperm whales generally occur along the shelf-edge and deeper, in warm-temperate to tropical waters (DoN, 2009g). Pygmy and dwarf sperm whales are difficult to distinguish and are often collectively referred to as *Kogia* spp. *Kogia* may occur seaward of the shelf break throughout the CHASN OPAREA and proposed Site B USWTR year-round. *Kogia* spp. occurring in the proposed Site B USWTR would be from the western North Atlantic stock. The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring et al., 2008).

The analysis results show that no Level A harassment of *Kogia* spp. and up to 30 incidents of behavioral disruption (Level B harassment) could occur annually (Table 4.3-9). These exposures would not necessarily occur to 30 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pygmy or dwarf sperm whales experiencing Level B harassment may be fewer than 30. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on pygmy or dwarf sperm whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for pygmy or dwarf sperm whales and would have a negligible impact on these species.

In terms of functional hearing capability pygmy and dwarf sperm whales belong to high-frequency cetaceans which have best hearing ranging from 200 Hz to 180 kHz. No information on hearing is available for the dwarf sperm whale. An ABR study completed on a stranded pygmy sperm whale indicated a hearing range of 90 to 150 kHz (Ridgway and Carder, 2001). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of pygmy or dwarf sperm whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response
may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts may not readily sight pygmy and dwarf sperm whales. Because pygmy and dwarf sperm whales are cryptic (difficult to detect at the surface) and deep diving, they have a relatively low detection probability, estimated by Barlow and Forney (2006) at 0.35. It is possible that modeled exposures resulting in behavioral disruption may be realized. Even though the pygmy and dwarf sperm whales may exhibit a reaction when initially exposed to active acoustic energy, the exposures are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures.

In accordance with NEPA, there would be no significant impact to pygmy or dwarf sperm whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to pygmy and dwarf sperm whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

**Beaked Whales – Site B**

Cuvier’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species expected to occur regularly in the Charleston OPAREA, with possible sightings of True’s and Sowerby’s beaked whales (DoN, 2008n). Beaked whales may occur in the area from the vicinity of the continental shelf break to seaward of the eastern boundary of the Charleston OPAREA. Beaked whales are expected in the vicinity of the shelf break and seaward in the Site B USWTR. The best estimate of *Mesoplodon* spp. and Cuvier’s beaked whale abundance combined in the western North Atlantic is 3,513 individuals (Waring et al., 2008).

The acoustic analysis indicates no exposures of beaked whales to sound levels that could cause Level A or B harassment (Table 4.3-9). The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for beaked whales.

Beaked whales functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007) though best hearing is presumed to occur at ultrasonic frequencies (MacLeod, 1999; DoN, 2000b). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod, 1999; DoN, 2000b). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais’ beaked whale using auditory evoked potential techniques (Cook et al., 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al., 2006). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.
In accordance with NEPA, there would be no significant impact to beaked whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to beaked whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

Rough-Toothed Dolphin – Site B

Four sightings in the JAX/CHASN OPAREA and a few strandings inshore of the OPAREA boundary confirm the presence of this species here throughout the year (DoN, 2008n). Based on the sighting records and the known preference of this species for deep waters, rough-toothed dolphin may occur seaward of the shelf break year-round on only a sporadic basis. The rough-toothed dolphin is expected seaward of the shelf break in Site B USWTR. There is no information on stock structure for rough-toothed dolphins in the North Atlantic. No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring et al., 2008).

The analysis results show that no Level A harassment and up to 12 incidents of behavioral disruption (Level B harassment) of rough-toothed dolphins could occur annually (Table 4.3-9). Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on rough-toothed dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for rough-toothed dolphins and would have a negligible impact on these species.

Functional hearing for rough-toothed dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Scientists have determined the rough-toothed dolphin can detect sounds between 5 and 80 kHz and probably much higher (Cook et al., 2005). The echolocation frequency range (0.1 to 200 kHz) of this species has some overlap with mid-frequency active and high-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of rough-toothed dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts would likely detect a group of rough-toothed dolphins at the surface because of rough-toothed dolphins’ high probability of detection (0.76 in Beaufort sea states of 6 or less; Barlow, 2006). Implementation of mitigation measures and probability of detecting large groups of rough-toothed dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to rough-toothed dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to rough-toothed dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.
Bottlenose Dolphin – Site B

The sighting data reflect that bottlenose dolphins are distributed mainly along the coast, across the continental shelf, over the continental shelf break, and in waters over the continental slope to the 4,000-m (13,120-ft) isobath. There is a concentrated occurrence of these dolphins from the coast to outside the continental shelf break over the upper continental slope. There is a low or unknown occurrence of bottlenose dolphins in waters with a bottom depth greater than 4,000 m (13,120 ft) (DoN, 2002d). The bottlenose dolphin may occur in the proposed Site B USWTR as well as throughout the CHASN OPAREA year-round. Bottlenose dolphins occurring on the proposed Site B USWTR would be from the western North Atlantic offshore stock. The best population estimate for this stock is 81,588 individuals (Waring et al., 2008).

The analysis estimates that up to 3,374 incidents of behavioral disruption (Level B harassment) would occur annually (Table 4.3-9). No incidents of Level A harassment are expected to occur. The 3,374 Level B exposures would not necessarily occur to 3,374 different individuals. The same bottlenose dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual bottlenose dolphins experiencing Level B harassment may be fewer than 3,374. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for all bottlenose dolphins and would have a negligible impact on this species.

Functional hearing for bottlenose dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007) with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Bottlenose dolphins communicate via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Signature whistles, which identify individual dolphins and are a dominant characteristic of communications between mothers and calves, range from 3.4 to 14.5 kHz, comparable to the 1 to 10 kHz range of mid-frequency active sonar. Potential Level B exposures from mid-frequency active sonar could therefore result in impaired communication between mother and calf pairs. In addition, experiments support the likelihood that some high-frequency active sonar frequencies could result in a behavioral response. Observed changes in behavior in one bottlenose dolphin were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa (DoN, 1997b; Schlundt et al., 2000). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of bottlenose dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

In accordance with NEPA, there would be no significant impact to bottlenose dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance
with EO 12114, there would be no significant harm to bottlenose dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

**Pantropical and Atlantic Spotted Dolphins – Site B**

Both the pantropical and Atlantic spotted dolphins are expected to occur from the coastline to seaward of the eastern boundary of the CHASN OPAREA throughout the year. The pantropical spotted dolphin is a deep-water species, and the Atlantic spotted dolphin may occur in both shelf and offshore waters (DoN, 2009g). Sightings of spotted dolphins in coastal waters are most likely of the Atlantic spotted dolphin. Either species could occur at the proposed Site B USWTR. Spotted dolphins occurring on the proposed Site B USWTR would be from the western North Atlantic stocks. In the western North Atlantic, the best abundance estimate for pantropical spotted dolphins is 4,439; for Atlantic spotted dolphins, it is 50,978 (Waring et al., 2008).

The acoustic model estimates that up to 3,026 incidents of behavioral disruption (Level B harassment) to spotted dolphins (621 pantropical and 2,405 Atlantic) would occur annually (Table 4.3-9). No incidents of Level A harassment are expected to occur. These exposures would not necessarily occur to 3,026 different individuals. The same spotted dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual spotted dolphins experiencing Level B harassment may be less than 3,026. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for either species of spotted dolphin, and impacts to the species would be negligible.

Functional hearing for pantropical spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Pantropical spotted dolphins communicate, feed and socialize via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995) which overlaps well with mid-frequency active sonar, while clicks are bimodal with peaks at 40 to 60 kHz and 120 to 140 kHz and more aligned with high frequency sonar (Schotten et al., 2004). Potential Level B exposures from mid-frequency active and high frequency sonar could therefore result in impaired communication, changes in foraging and social interaction. However, any behavioral responses are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.

Functional hearing for Atlantic spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Atlantic spotted dolphins produce a variety of sounds in frequencies from .1 to above 100 kHz. Whistles range from 7.1 to 14.5 kHz which overlaps with mid-frequency active sonar (1 to 10 kHz) while echolocation clicks ranging from 40 to 130 kHz overlap well with high frequency
sonar. Some communication does occur at frequencies below that for mid-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of Atlantic spotted dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Given their frequent surfacing, large group size encompassing hundreds of animals (Leatherwood and Reeves, 1982) and probability of trackline detection of 1.00 in Beaufort sea states of 6 or less (Barlow, 2006), lookouts would likely detect both Atlantic and pantropical spotted dolphins at the surface. Implementation of mitigation measures and probability of detection reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Atlantic and pantropical spotted dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to Atlantic and pantropical spotted dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

**Striped Dolphin – Site B**

In the JAX/CHASN OPAREA, there are only two sightings of the striped dolphin (DoN, 2008n). Several strandings are recorded inshore of the OPAREA boundaries during all seasons and striped dolphins may occur in the Charleston OPAREA year-round (DoN, 2008n). The striped dolphin is expected near and seaward of the shelf break in Site B USWTR. The best estimate of striped dolphin abundance in the western North Atlantic is 94,462 individuals (Waring et al., 2008).

The acoustic model indicates that no striped dolphins will be exposed to acoustic levels likely to result in Level A or Level B harassment (Table 4.3-9).

Functional hearing for striped dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Kastelein et al., (2003) determined the hearing sensitivity of a single striped dolphin to range from 0.5 to 160 kHz with best sensitivity at 64 kHz. Assuming this study may be applicable to striped dolphins in general, the frequency of best sensitivity for this species is much higher than the range of frequencies for mid-frequency active sonar but aligns well with that of high-frequency active sonar. Dominant frequencies of whistles ranged from 8 to 12.5 kHz (Thomson and Richardson, 1995).

Given their gregarious behavior and large group size of up to several hundred or even thousands of animals (Baird et al., 1993), it is likely that lookouts would detect a group of striped dolphins.
at the surface. Implementation of mitigation measures and probability of detecting large groups of striped dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to striped dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to striped dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

Clymene Dolphin – Site B

Clymene dolphins may occur in waters seaward of the shelf break throughout the CHASN OPAREA (DoN, 2008n). The Clymene dolphin is expected seaward of the shelf break in proposed Site B USWTR. Clymene dolphins occurring on the proposed Site B USWTR would be from the western North Atlantic stock. The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring et al., 2008).

The modeling effort and harassment analysis estimate no Level A harassment of Clymene dolphins. The analysis estimates that up to 297 incidental exposures of a Clymene dolphin to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-9). These exposures would not necessarily occur to 297 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Clymene dolphins experiencing Level B harassment may be fewer than 297. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on Clymene dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for Clymene dolphins, and would have a negligible impact on this species.

Functional hearing for Clymene dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in frequency (range of 6.3 to 19.2 kHz). This frequency range has some overlap with mid-frequency active sonar and aligns well with the lower end of the high-frequency active frequency range.

Given their gregarious behavior and potentially large group size of up to several hundred or even thousands of animals (Jefferson, 2006), it is likely that lookouts would detect a group of Clymene dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Clymene dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Clymene dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to Clymene dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.
Common Dolphin – Site B

Although the common dolphin is often found along the shelf-edge, there are sighting and bycatch records in shallower waters to the north, as well as sightings on the continental shelf in the JAX/CHASN OPAREA (DoN, 2008n). Based on the cool water temperature preferences of this species and available sighting data, there is likely a very low possibility of encountering common dolphins only during the winter, spring, and fall throughout the CHASN OPAREA (DoN, 2008n). Common dolphins may occur in the Site B USWTR during this time of year. While there are a number of historical stranding records for common dolphins during the summer, there have been no recent confirmed records for this species. Therefore, common dolphins are not expected to occur in the Site B USWTR during the summer. The best estimate of abundance for the Western North Atlantic *Delphinus* spp. stock is 120,743 individuals (Waring et al., 2008).

The acoustic model indicates that no common dolphins will be exposed to acoustic levels likely to result in Level A or Level B harassment (Table 4.3-9).

Functional hearing for common dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). This species’ hearing range extends from 10 to 150 kHz with greatest sensitivity from 60 to 70 kHz (Popov and Klishin, 1998). This species range of best hearing aligns well with high-frequency active sonar frequencies.

Given their gregarious behavior and large group size of up to thousands of animals (Jefferson et al. 1993), it is likely that lookouts would detect a group of common dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of common dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to common dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR*. In accordance with EO 12114, there would be no significant harm to common dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

Risso’s Dolphin – Site B

Risso’s dolphin may occur year-round along the path of the Gulf Stream and including steep portions of the continental slope in the CHASN OPAREA, along the shelf break and extending seaward over the continental slope throughout the area, with seasonal variations (DoN, 2008n). Risso’s dolphins are expected in the vicinity of the shelf break and seaward within the proposed Site B USWTR. Risso’s dolphins occurring on the proposed Site B USWTR would be from the western North Atlantic stock. The best estimate of Risso’s dolphin abundance in the western North Atlantic is 20,479 individuals (Waring et al., 2008).

The modeling results show that no Level A harassment of Risso’s dolphin would occur. The analysis results show that up to 775 incidental exposures of Risso’s dolphins to non-injurious
levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-9). These exposures would not necessarily occur to 775 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Risso’s dolphins experiencing Level B harassment may be fewer than 775. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for Risso’s dolphins and would have a negligible impact on this species.

Functional hearing for Risso’s dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Nachtigall et al. (1995; 2005) measured hearing in an adult and an infant Risso’s dolphin. The adult hearing ranged from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. The infant could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz, well above mid-frequency active sonar frequencies but well within the high-frequency active sonar frequency range. The intersection of common frequencies between Risso’s dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Given the frequent surfacing behavior and large group size of Risso’s dolphins (Leatherwood and Reeves, 1982), it is likely that lookouts would detect a group of Risso’s dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Risso’s dolphins reduce the likelihood of exposure.

_In accordance with NEPA, there would be no significant impact to Risso’s dolphins in territorial waters from acoustic effects related to the proposed Site B USWTR._ In accordance with EO 12114, there would be no significant harm to Risso’s dolphins in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

**Pilot Whales – Site B**

There are two species of pilot whales in the western Atlantic: the Atlantic, or long-finned, pilot whale and the short-finned pilot whale. These species are difficult to identify to the species level at sea; therefore, the descriptive material often refers to them collectively. Based upon the two species’ distributions, the pilot whales found in the CHASN OPAREA are probably short-finned pilot whales. Short-finned pilot whales may occur throughout the CHASN OPAREA during most of the year (DoN, 2008n). Short-finned pilot whales are expected in proposed Site B USWTR. Pilot whales occurring in the proposed Site B USWTR would be from the western North Atlantic stock of short-finned pilot whales. The best estimate of pilot whale abundance (combined short-finned and long-finned) in the western North Atlantic is 31,139 individuals (Waring et al., 2008). Separate population estimates for short-finned and long-finned pilot whales are not available.
The modeling results show no Level A exposures and up to 764 incidental exposures of pilot whales to non-injurious levels of acoustic harassment (Level B harassment) on an annual basis (Table 4.3-9). These exposures would not necessarily occur to 764 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pilot whales experiencing Level B harassment may be fewer than 764. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on pilot whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for all pilot whales and would have a negligible impact on these species.

Functional hearing for pilot whales is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz. Communication frequencies for pilot whales therefore align well with both mid-frequency active and high-frequency active sonar frequencies. High-frequency active sonar frequencies above 60 kHz may or may not result in a response. If a pilot whale does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Pilot whale group size typically ranges from several to several hundred individuals (Jefferson et al., 1993). Given the large body size, gregarious behavior, and group size of pilot whales, it is likely that lookouts would detect a group of pilot whales at the surface. Implementation of mitigation measures and probability of detecting groups of pilot whales reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to pilot whales in territorial waters from acoustic effects related to the proposed Site B USWTR. In accordance with EO 12114, there would be no significant harm to pilot whales in non-territorial waters from acoustic effects related to the proposed Site B USWTR.

4.3.9.3 Site C

The following subchapter presents the marine mammal incidental harassment estimates for the proposed Site C USWTR. Only species predicted to experience one or more incidents of harassment are presented here, and these numbers reflect the species, numbers, and type of harassment for which a MMPA LOA would be requested if the Site C became the Navy’s preferred alternative. Note that ESA listed species are not included on these tables, as information on these species was presented for each USWTR alternative in Subchapter 4.3.8.

Information on the species population and/or stock is provided for species where harassment authorization is requested. The text also describes the rationale behind any differences between the Appendix D raw acoustic impact model outputs and Table 4.3-10. The population estimates for each species were taken from the NMFS stock assessments reports for 2007 (Waring et al., 2008).
**Minke Whale – Site C**

There are no records of minke whales within the CHPT OPAREA; however, scattered sighting and stranding records just outside of the OPAREA boundaries indicate the presence of this species (DoN, 2008l). The lack of sighting data is likely due to incomplete survey coverage in the OPAREA, especially during spring and fall. Minke whales may occur in the CHPT OPAREA in the spring, winter, and fall. During the summer, minke whales are expected to occur at higher latitudes on their feeding grounds; however they may occur in the OPAREA, particularly the northern portion. Minke whales are expected to occur in the Site C USWTR. The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring et al., 2008).

The harassment analysis results show that no Level A harassment of minke whales would occur. The modeling shows that up to eight incidental exposures of minke whales to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-10). Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on minke whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for minke whales and would have a negligible impact on this species.

In terms of functional hearing capability, minke whales belong to low-frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific minke whale hearing ranges. Exposure to high-frequency active sonar that is above the functional hearing capability of minke whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Due to the conspicuousness of this species at the surface, lookouts would likely detect a group of minke whales at the surface given their large size (up to 8 m [27 ft]), pronounced blow, and breaching behavior (Barlow, 2005).

*In accordance with NEPA, there would be no significant impact to minke whales in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to minke whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.*
Pygmy and Dwarf Sperm Whales – Site C

In the North Atlantic, pygmy and dwarf sperm whales generally occur along the shelf-edge and deeper, in warm-temperate to tropical waters (DoN, 2009g). Pygmy and dwarf sperm whales are difficult to distinguish and are often collectively referred to as *Kogia* spp. *Kogia* may occur over and seaward of the shelf break throughout the year. Pygmy and dwarf sperm whales are expected to occur in the proposed Site C USWTR. *Kogia* spp. occurring in the proposed Site C USWTR would be from the western North Atlantic stock. The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring et al., 2008).

The analysis results show that no Level A harassment of *Kogia* spp. and up to 165 incidents of behavioral disruption (Level B harassment) could occur annually (Table 4.3-10). These exposures would not necessarily occur to 165 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pygmy or dwarf sperm whales experiencing Level B harassment may be fewer than 165. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on pygmy or dwarf sperm whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for pygmy or dwarf sperm whales and would have a negligible impact on these species.

In terms of functional hearing capability, pygmy and dwarf sperm whales belong to high-frequency cetaceans which have best hearing ranging from 200 Hz to 180 kHz. No information on hearing is available for the dwarf sperm whale. An ABR study completed on a stranded pygmy sperm whale indicated a hearing range of 90 to 150 kHz (Ridgway and Carder, 2001). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of pygmy or dwarf sperm whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts may not readily sight pygmy and dwarf sperm whales. Because pygmy and dwarf sperm whales are cryptic (difficult to detect at the surface) and deep diving, they have a relatively low detection probability, estimated by Barlow and Forney (2006) at 0.35. It is possible that modeled exposures resulting in behavioral disruption may be realized. Even though the pygmy and dwarf sperm whales may exhibit a reaction when initially exposed to active acoustic energy, the exposures are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures.

*In accordance with NEPA, there would be no significant impact to pygmy or dwarf sperm whales in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to pygmy and dwarf sperm whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.*
Beaked Whales – Site C

Based upon available data, six beaked whales are known to occur in the CHPT OPAREA: Cuvier's beaked whales, northern bottlenose whales, and four members of the genus *Mesoplodon* (True's, Gervais', Blainville's, and Sowerby's beaked whales). Cuvier’s, True’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species expected to occur regularly in the OPAREA, with possible sightings of Sowerby’s beaked whales and one extralimital record of a northern bottlenose whale inshore of the CHPT OPAREA (DoN, 2008l). There are very few sighting records of beaked whales in the CHPT OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA (DoN, 2008l), where beaked whales are expected to occur. Beaked whales may occur seaward of the shelf break throughout the year. Beaked whales are expected to occur seaward of the shelf break in Site C USWTR. The best estimate of *Mesoplodon* spp. and Cuvier’s beaked whale abundance combined in the western North Atlantic is 3,513 individuals (Waring et al., 2008).

The modeling estimates that up to 3 incidental exposures of beaked whales to sound levels that could cause behavioral disruption may occur on an annual basis (Table 4.3-10). These exposures would not necessarily occur to 3 different individuals. The same beaked whale could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual beaked whales experiencing harassment may be fewer than 3. Further, mitigation measures detailed in Chapter 6 should reduce the potential for impact on beaked whales. Thus, the Navy concludes that the proposed action would not affect annual rates of recruitment or survival for *Mesoplodon* and *Ziphius* beaked whales.

Beaked whales’ functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007) though best hearing is presumed to occur at ultrasonic frequencies (MacLeod, 1999; DoN, 2000b). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod, 1999; DoN, 2000b). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais’ beaked whale using auditory evoked potential techniques (Cook et al., 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al., 2006). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

*In accordance with NEPA, there would be no significant impact to beaked whales in territorial waters from acoustic effects related to the proposed Site C USWTR.* In accordance with EO 12114, there would be no significant harm to beaked whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.
Rough-Toothed Dolphin – Site C

The rough-toothed dolphin is regarded as an offshore species that prefers deep waters; however, it can occur in waters with variable bottom depths (e.g., Gannier and West, 2005). The rough-toothed dolphin is expected to occur seaward of the shelf break in the proposed Site C USWTR. There is no information on stock structure for rough-toothed dolphins in the North Atlantic. No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring et al., 2008).

The analysis results show that no Level A harassment of rough-toothed dolphin and up to 78 incidents of behavioral disruption (Level B harassment) could occur annually (Table 4.3-10). The 78 Level B exposures would not necessarily occur to 78 different individuals. The same rough-toothed dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual bottlenose dolphins experiencing Level B harassment may be fewer than 78. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on rough-toothed dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for rough-toothed dolphins and would have a negligible impact on these species.

Functional hearing for rough-toothed dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Scientists have determined the rough-toothed dolphin can detect sounds between 5 and 80 kHz and probably much higher (Cook et al., 2005). The echolocation frequency range (0.1 to 200 kHz) of this species has some overlap with mid-frequency active and high-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of rough-toothed dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts would likely detect a group of rough-toothed dolphins at the surface because of rough-toothed dolphins’ high probability of detection (0.76 in Beaufort sea states of 6 or less; Barlow, 2006). Implementation of mitigation measures and probability of detecting large groups of rough-toothed dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to rough-toothed dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to rough-toothed dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.
Bottlenose Dolphin – Site C

The bottlenose dolphins stocks that are likely found in the proposed Site C USWTR area would be part of the western North Atlantic offshore stock that migrates north and south along the U.S. east coast in response to movement of small schooling fishes. This stock ranges from Florida to New Jersey. The best population estimate for this stock is 81,588 individuals (Waring et al., 2008).

The analysis results show that one Level A harassment of bottlenose dolphins and up to 22,101 incidents of behavioral disruption (Level B harassment) would occur annually (Table 4.3-10). These exposures would not necessarily occur to 22,101 different individuals. The same bottlenose dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual bottlenose dolphins experiencing Level B harassment may be fewer than 22,101. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for all bottlenose dolphins and would have a negligible impact on this species.

Functional hearing for bottlenose dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007) with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Bottlenose dolphins communicate via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Signature whistles, which identify individual dolphins and are a dominant characteristic of communications between mothers and calves, range from 3.4 to 14.5 kHz, comparable to the 1 to 10 kHz range of mid-frequency active sonar. Potential Level B exposures from mid-frequency active sonar could therefore result in impaired communication between mother and calf pairs. In addition, experiments support the likelihood that some high-frequency active sonar frequencies could result in a behavioral response. Observed changes in behavior in one bottlenose dolphin were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa (DoN, 1997b; Schlundt et al., 2000). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of bottlenose dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

*In accordance with NEPA, there would be no significant impact to bottlenose dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to bottlenose dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.*
Pantropical and Atlantic Spotted Dolphins – Site C

Atlantic spotted dolphins may occur in both continental shelf and offshore waters of the CHPT OPAREA year-round. Pantropical spotted dolphins may occur seaward of the shelf break throughout the OPAREA year-round. Either species may be found in the proposed Site C USWTR at any time of year. The spotted dolphins stocks that are likely found in the Site C USWTR area would be part of the southeast Atlantic and Gulf of Mexico/western North Atlantic stocks of pantropical spotted dolphin and the western North Atlantic spotted dolphin. Both species are found in warm-to-temperate open ocean waters from Cape Hatteras to Florida and into the Gulf of Mexico. In the western North Atlantic, the best abundance estimate for pantropical spotted dolphins is 4,439; for Atlantic spotted dolphins, it is 50,978 (Waring et al., 2008).

The modeling effort and harassment analysis estimate fewer than one incident of Level A harassment of spotted dolphins annually. The mitigation measures detailed in Chapter 6 would eliminate this low probability of injurious effect on spotted dolphins; therefore, no Level A incidental harassment is anticipated for this species.

The analysis estimates that up to 17,982 incidental exposures of spotted dolphins (3,628 pantropical and 14,354 Atlantic) to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-10). These exposures would not necessarily occur to 17,982 different individuals. The same spotted dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual spotted dolphins experiencing Level B harassment may be less than 17,982. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for either species of spotted dolphin, and impacts to the species would be negligible.

Functional hearing for pantropical spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Pantropical spotted dolphins communicate, feed and socialize via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995) which overlaps well with mid-frequency active sonar, while clicks are bimodal with peaks at 40 to 60 kHz and 120 to 140 kHz and more aligned with high frequency sonar (Schotten et al., 2004). Potential Level B exposures from mid-frequency active and high frequency sonar could therefore result in impaired communication, changes in foraging and social interaction. However, any behavioral responses are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.
Functional hearing for Atlantic spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Atlantic spotted dolphins produce a variety of sounds in frequencies from .1 to above 100 kHz. Whistles range from 7.1 to 14.5 kHz which overlaps with mid-frequency active sonar (1 to 10 kHz) while echolocation clicks ranging from 40 to 130 kHz overlap well with high frequency sonar. Some communication does occur at frequencies below that for mid-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of Atlantic spotted dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Given their frequent surfacing, large group size encompassing hundreds of animals (Leatherwood and Reeves, 1982) and probability of trackline detection of 1.00 in Beaufort sea states of 6 or less (Barlow, 2006), lookouts would likely detect both Atlantic and pantropical spotted dolphins at the surface. Implementation of mitigation measures and probability of detection reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Atlantic and pantropical spotted dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to Atlantic and pantropical spotted dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

**Striped Dolphin – Site C**

In the CHPT OPAREA, there is only one record of this species, which is a sighting near the northern perimeter of the OPAREA (DoN, 2008l). The paucity of sighting data for striped dolphins in this area is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA, as well as this species’ preference for more temperate waters further north (Waring and Palka, 2002). Sightings have been recorded just north of the OPAREA boundary (DoN 2008l). Several strandings are recorded inshore of the CHPT OPAREA boundaries during all seasons and support the likelihood of striped dolphin occurrence in Site C USWTR. Striped dolphins may occur near and seaward of the shelf break in the Site C USWTR. The best estimate of striped dolphin abundance in the western North Atlantic is 94,462 individuals (Waring et al., 2008).

The acoustic model indicates that no striped dolphins will be exposed to acoustic levels likely to result in Level A or Level B harassment (Table 4.3-10).

Functional hearing for striped dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Kastelein et al., (2003) determined the hearing sensitivity of a single striped dolphin to range from 0.5 to 160
kHz with best sensitivity at 64 kHz. Assuming this study may be applicable to striped dolphins in general, the frequency of best sensitivity for this species is much higher than the range of frequencies for mid-frequency active sonar but aligns well with that of high-frequency active sonar. Dominant frequencies of whistles ranged from 8 to 12.5 kHz (Thomson and Richardson, 1995).

Given their gregarious behavior and large group size of up to several hundred or even thousands of animals (Baird et al., 1993), it is likely that lookouts would detect a group of striped dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of striped dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to striped dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR.* In accordance with EO 12114, there would be no significant harm to striped dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

### Clymene Dolphin – Site C

Clymene dolphins show a preference for deep waters. They may occur in waters seaward of the shelf break throughout the CHPT OPAREA, including the proposed Site C USWTR. Clymene dolphins occurring on the proposed Site C USWTR would be from the western North Atlantic stock. The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring et al., 2008).

The modeling effort and harassment analysis estimate no Level A harassment of Clymene dolphins. The analysis estimates that up to 1,733 incidental exposures of a Clymene dolphin to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-10). These exposures would not necessarily occur to 1,733 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Clymene dolphins experiencing Level B harassment may be fewer than 1,733. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on Clymene dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for Clymene dolphins, and would have a negligible impact on this species.

Functional hearing for Clymene dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in frequency (range of 6.3 to 19.2 kHz). This frequency range has some overlap with mid-frequency active sonar and aligns well with the lower end of the high-frequency active frequency range.
Given their gregarious behavior and potentially large group size of up to several hundred or even thousands of animals (Jefferson, 2006), it is likely that lookouts would detect a group of Clymene dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Clymene dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to Clymene dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR.* In accordance with EO 12114, there would be no significant harm to Clymene dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

**Common Dolphin – Site C**

Common dolphins occur along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). In winter, the common dolphin may occur north of the CHPT OPAREA near the northern wall of the Gulf Stream (DoN, 2008l). This is a region of enhanced primary productivity resulting in localized prey concentrations. Common dolphins may occur in the northern portion of the OPAREA near Cape Hatteras, including waters over the continental shelf and slope as well as nearshore waters (DoN, 2008l). Common dolphins are expected to occur in the proposed Site C USWTR. The best population estimate for this stock is 120,743 individuals (Waring et al. 2008).

The acoustic analysis estimates that up to one incidental exposure of common dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur (Table 4.3-10). Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on common dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for common dolphins, and would have a negligible impact on this species.

Functional hearing for common dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). This species’ hearing range extends from 10 to 150 kHz with greatest sensitivity from 60 to 70 kHz (Popov and Klishin, 1998). This species range of best hearing aligns well with high-frequency active sonar frequencies.

Given their gregarious behavior and large group size of up to thousands of animals (Jefferson et al. 1993), it is likely that lookouts would detect a group of common dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of common dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to common dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR.* In accordance with EO 12114, there would be no significant harm to common dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.
Risso’s Dolphin – Site C

Risso’s dolphins are most commonly found in areas with steep bottom topography and are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Sightings within the CHPT OPAREA generally follow this pattern of distribution along the path of the Gulf Stream and including steep portions of the continental slope (DoN, 2008l). Risso’s dolphins may occur near and seaward of the shelf break in the CHPT OPAREA. Risso’s dolphins are expected to occur in the vicinity of the shelf break and seaward of the shelf break in the proposed Site C USWTR. Risso’s dolphins occurring on the proposed Site C USWTR would be from the western North Atlantic stock. The best estimate of Risso’s dolphin abundance in the western North Atlantic is 20,479 individuals (Waring et al., 2008).

The modeling effort and harassment analysis estimate that no Level A harassment of Risso’s dolphin would occur. The analysis estimates that up to 355 incidental exposures of Risso’s dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-10). These exposures would not necessarily occur to 355 different individuals. The same Risso’s dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Risso’s dolphins experiencing Level B harassment may be fewer than 355. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for Risso’s dolphin and would have a negligible impact on this species.

Functional hearing for Risso’s dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Nachtigall et al. (1995; 2005) measured hearing in an adult and an infant Risso’s dolphin. The adult hearing ranged from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. The infant could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz, well above mid-frequency active sonar frequencies but well within the high-frequency active sonar frequency range. The intersection of common frequencies between Risso’s dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Given the frequent surfacing behavior and large group size of Risso’s dolphins (Leatherwood and Reeves, 1982), it is likely that lookouts would detect a group of Risso’s dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Risso’s dolphins reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to Risso’s dolphins in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to Risso’s dolphins in non-territorial waters from acoustic effects related to the proposed Site C USWTR.*
Pilot Whales – Site C

There are two species of pilot whales in the western Atlantic: the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to identify to the species level at sea; therefore, the descriptive material often refers to them collectively. The species boundary is considered to be in the New Jersey to Cape Hatteras area. The pilot whale stocks in the proposed Site C USWTR area would most likely be part of the western North Atlantic short-finned pilot whale stock. Pilot whales in the vicinity of the proposed Site C USWTR would occur along the shelf break and onto the continental slope. Pilot whales occurring in the proposed Site C USWTR would be from the western North Atlantic stocks. The best estimate of pilot whale abundance (combined short-finned and long-finned) in the western North Atlantic is 31,139 individuals (Waring et al., 2008).

The modeling effort and harassment analysis estimate that no Level A harassment of pilot whales would occur. The analysis estimates that up to 542 incidents of non-injurious behavioral harassment (Level B harassment) may be experienced by pilot whales on an annual basis (Table 4.3-10). These exposures would not necessarily occur to 542 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pilot whales experiencing Level B harassment may be fewer than 542. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on pilot whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for pilot whales, and would have a negligible impact on these species.

Functional hearing for pilot whales is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz. Communication frequencies for pilot whales therefore align well with both mid-frequency active and high-frequency active sonar frequencies. High-frequency active sonar frequencies above 60 kHz may or may not result in a response. If a pilot whale does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Pilot whale group size typically ranges from several to several hundred individuals (Jefferson et al., 1993). Given the large body size, gregarious behavior, and group size of pilot whales, it is likely that lookouts would detect a group of pilot whales at the surface. Implementation of mitigation measures and probability of detecting groups of pilot whales reduce the likelihood of exposure.

*In accordance with NEPA, there would be no significant impact to pilot whales in territorial waters from acoustic effects related to the proposed Site C USWTR.* In accordance with EO 12114, there would be no significant harm to pilot whales in non-territorial waters from acoustic effects related to the proposed Site C USWTR.
Harbor Porpoise – Site C

The harbor porpoise primarily occurs on the continental shelf, in cool temperate to subpolar waters (Read, 1999) that are at higher latitudes than the CHPT OPAREA. Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP, 1982; Northridge, 1996). Intermediate densities of harbor porpoises are found in waters off North Carolina during winter (January through March) (Waring et al., 2007). Harbor porpoises may occur along the continental shelf in the northern part of the CHPT OPAREA in winter, based on sighting and bycatch records north of Cape Hatteras and the large number of strandings recorded inshore of the OPAREA (DoN, 2008). The harbor porpoise is expected to occur in Site C USWTR. Harbor porpoises occurring along the eastern seaboard of the U.S. are from the Gulf of Maine and Bay of Fundy stock. The best estimate of abundance for this stock is 89,054 individuals (Waring et al., 2008).

Insufficient data exist to calculate density estimates for the harbor porpoise in the CHPT OPAREA. No Level A or Level B exposures are expected for harbor porpoises at the proposed Site C USWTR.

In terms of functional hearing capability, the harbor porpoise belongs to high-frequency cetaceans which have best hearing ranging from 200 Hz to 180 kHz. For sounds produced by this species the dominant frequency range is 110 to 150 kHz (Ketten, 1998; Villadsgaard, 2007), though some echolocation signals include one or two low-frequency components in the 1.4 to 2.5 kHz range (Verboom and Kastelein, 1995). Thus, with the exception of some echolocation signals, most sound production occurs above mid-frequency active sonar frequencies but overlaps well with the upper component of high-frequency active sonar frequencies. High-frequency active sonar frequencies below 110 kHz and above 150 kHz may or may not result in a response. If a harbor porpoise does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

In accordance with NEPA, there would be no significant impact to harbor porpoises in territorial waters from acoustic effects related to the proposed Site C USWTR. In accordance with EO 12114, there would be no significant harm to harbor porpoises in non-territorial waters from acoustic effects related to the proposed Site C USWTR.

4.3.9.4 Site D

The following subchapter presents the marine mammal incidental harassment estimates for the proposed Site D USWTR. Only species predicted to experience one or more incidents of harassment are presented here, and these numbers reflect the species, numbers, and type of harassment for which a MMPA LOA would be requested if Site D became the Navy’s preferred alternative. Note that ESA listed species are not included on these tables, as information on these species was presented for each USWTR alternative in Subchapter 4.3.8.
Information on the species population and/or stock is provided for each species. The text also describes the rationale behind any differences between the Appendix D raw acoustic impact model outputs and Table 4.3-11. The population estimates for each species were taken from the NMFS stock assessments reports for 2007 (Waring et al., 2008).

**Minke Whale – Site D**

Minke whales generally occur north of the VACAPES OPAREA (DoN, 2008m). Most sightings in the OPAREA and vicinity are recorded in spring over the continental shelf; few are scattered in slope waters just beyond the shelf break (DoN, 2008m). The paucity of sighting data in deep water is likely due to incomplete survey coverage in the OPAREA, especially during winter and fall. Minke whales may occur throughout the OPAREA and the Site D USWTR year-round. The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring et al., 2008).

The harassment analysis results show that no Level A harassment of minke whales would occur. The modeling shows that up to six incidental exposures of minke whales to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on minke whales. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for minke whales and would have a negligible impact on this species.

In terms of functional hearing capability minke whales belong to low-frequency cetaceans which have best hearing ranging from 7 Hz to 22 kHz. There are no tests or modeling estimates of specific minke whale hearing ranges. Exposure to high-frequency active sonar that is above the functional hearing capability of minke whales may not elicit a behavioral response since the frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

Due to the conspicuousness of this species at the surface, lookouts would likely detect a group of minke whales at the surface given their large size (up to 8 m [27 ft]), pronounced blow, and breaching behavior (Barlow, 2005).

*In accordance with NEPA, there would be no significant impact to minke whales in territorial waters from acoustic effects related to the proposed Site D USWTR.* In accordance with EO 12114, there would be no significant harm to minke whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.
Pygmy and Dwarf Sperm Whales – Site D

Pygmy and dwarf sperm whales are difficult to distinguish and are often collectively referred to as *Kogia* spp. There are limited sighting data for the cryptic *Kogia* spp. in the VACAPES OPAREA. Summer is the only season for which there are sighting records. Nonetheless, they are expected to occur in parts of the VACAPES OPAREA year round. *Kogia* spp. may occur in the proposed Site D USWTR at any time of year. *Kogia* spp. occurring in the proposed Site D USWTR would be from the western North Atlantic stock. The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring et al., 2008).

The analysis results show that no Level A harassment and up to 138 incidents of non-injurious behavioral disruption (Level B harassment) of pygmy or dwarf sperm whales would occur annually (Table 4.3-11). These exposures would not necessarily occur to 138 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pygmy or dwarf sperm whales experiencing Level B harassment may be fewer than 138. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on these species. The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for pygmy or dwarf sperm whales and would have a negligible impact on these species.

In terms of functional hearing capability, pygmy and dwarf sperm whales belong to high-frequency cetaceans which have best hearing ranging from 200 Hz to 180 kHz. No information on hearing is available for the dwarf sperm whale. An ABR study completed on a stranded pygmy sperm whale indicated a hearing range of 90 to 150 kHz (Ridgway and Carder, 2001). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of pygmy or dwarf sperm whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts may not readily sight pygmy and dwarf sperm whales. Because pygmy and dwarf sperm whales are cryptic (difficult to detect at the surface) and deep diving, they have a relatively low detection probability, estimated by Barlow and Forney (2006) at 0.35. It is possible that modeled exposures resulting in behavioral disruption may be realized. Even though the pygmy and dwarf sperm whales may exhibit a reaction when initially exposed to active acoustic energy, the exposures are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures.

*In accordance with NEPA, there would be no significant impact to pygmy or dwarf sperm whales in territorial waters from acoustic effects related to the proposed Site D USWTR.* In accordance with EO 12114, there would be no significant harm to pygmy and dwarf sperm whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.
Beaked Whales – Site D

Cuvier’s, True’s, Gervais’, and Blainville’s beaked whales are the only beaked whale species expected to occur regularly in the VACAPES OPAREA, with possible sightings of Sowerby’s beaked whales (DoN, 2008m). There is one extralimital stranding record of a northern bottlenose whale (in the beaked whale family) inshore of the VACAPES OPAREA. Beaked whales may occur over the shelf break and seaward throughout the year in the VACAPES OPAREA. Beaked whales are expected to occur seaward of the shelf break in the Site D USWTR year-round. The best estimate of *Mesoplodon* spp. and Cuvier’s beaked whale abundance combined in the western North Atlantic is 3,513 individuals (Waring et al., 2008).

The modeling estimates that up to 128 incidental exposures of beaked whales to sound levels that could cause behavioral disruption may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 128 different individuals. The same beaked whale could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual beaked whales experiencing harassment may be fewer than 128. Further, mitigation measures detailed in Chapter 6 should reduce the potential for impact on beaked whales. Thus, the Navy concludes that the proposed action would not affect annual rates of recruitment or survival for *Mesoplodon* and *Ziphius* beaked whales.

Beaked whales’ functional hearing range is estimated to occur between approximately 150 Hz and 160 kHz, placing them in the mid-frequency cetacean group (Southall, 2007) though best hearing is presumed to occur at ultrasonic frequencies (MacLeod, 1999; DoN, 2000b). However, due to their physiology, they may be more sensitive than other cetaceans to low-frequency sounds as well (MacLeod, 1999; DoN, 2000b). The only direct measure of beaked whale hearing is from a stranded juvenile Gervais’ beaked whale using auditory evoked potential techniques (Cook et al., 2006). The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz (Cook et al., 2006). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of beaked whales may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

In accordance with NEPA, there would be no significant impact to beaked whales in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to beaked whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

Atlantic White-sided Dolphin – Site D

White-sided dolphin sightings are recorded mostly in the northern VACAPES OPAREA and vicinity. Strandings and bycatch records are also documented near the OPAREA (DoN, 2008m). Due to this species’ preference for colder waters, the Gulf Stream may be a southern boundary.
for Atlantic white-sided dolphin distribution. This species may occur primarily in waters over the continental shelf throughout the OPAREA year-round. However, distribution may also range farther offshore which is evidenced by the sighting records offshore in waters over the continental slope in and near the OPAREA (DoN, 2008m). The Atlantic white-sided dolphin may occur in the Site D USWTR. The total number of Atlantic white-sided dolphins along the U.S. and Canadian Atlantic coast is unknown. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 63,368 (Waring et al., 2008).

Insufficient data exist to calculate density estimates for the Atlantic white-sided dolphin in the VACAPES OPAREA. No Level A or Level B exposures are expected for Atlantic white-sided dolphins at the proposed Site D USWTR.

Atlantic white-sided dolphins belong to the mid-frequency functional hearing group (Southall, 2007) though no hearing data is available for this species. Vocalization data indicate the dominant vocal frequency is 6 to 15 kHz (Thomson and Richardson, 1995), which overlaps well with mid-frequency active sonar and the lower end of high-frequency active sonar.

Group size of Atlantic white-sided dolphins ranges from a few to a few hundred individuals and seems to vary geographically; the typical average group size is about 50 animals (CETAP, 1982; Weinrich et al., 2001). Given their typical group size and level of surface activity, it is likely that lookouts would detect a group of Atlantic white-sided dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of white-sided dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Atlantic white-sided dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to Atlantic white-sided dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

Rough-Toothed Dolphin – Site D

Rough-toothed dolphins may occur seaward of the shelf break based on this species’ preference for deep waters. During the winter, the rough-toothed dolphin’s occurrence is expected in warmer waters, so occurrence in the VACAPES OPAREA may follow the western edge of the Gulf Stream. The rough-toothed dolphin may occur in the VACAPES OPAREA year-round. The rough-toothed dolphin is expected to occur seaward of the shelf break in the proposed Site D USWTR site. There is no information on stock structure for rough-toothed dolphins in the North Atlantic. No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring et al., 2008).

The analysis results show that no Level A harassment of rough-toothed dolphins and up to 65 incidents of behavioral disruption (Level B harassment) could occur annually (Table 4.3-11). The 65 Level B exposures would not necessarily occur to 65 different individuals. The same rough-toothed dolphin could be exposed multiple times over the course of a year, particularly if
the animal is resident in the area of the range. Thus, the estimated number of individual bottlenose dolphins experiencing Level B harassment may be fewer than 65. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on rough-toothed dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for rough-toothed dolphins and would have a negligible impact on these species.

Functional hearing for rough-toothed dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Scientists have determined the rough-toothed dolphin can detect sounds between 5 and 80 kHz and probably much higher (Cook et al., 2005). The echolocation frequency range (0.1 to 200 kHz) of this species has some overlap with mid-frequency active and high-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of rough-toothed dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Lookouts would likely detect a group of rough-toothed dolphins at the surface because of rough-toothed dolphins’ high probability of detection (0.76 in Beaufort sea states of 6 or less; Barlow, 2006). Implementation of mitigation measures and probability of detecting large groups of rough-toothed dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to rough-toothed dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to rough-toothed dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

**Bottlenose Dolphin – Site D**

The sighting data show that bottlenose dolphins are distributed mainly along the coast, across the continental shelf, over the continental shelf edge, and in waters over the continental slope with a bottom depth greater than 1,000 m (3,300 ft). Bottlenose dolphins occur in the VACAPES OPAREA year-round. Bottlenose dolphin occurrence is assumed to be the same for spring, summer, and fall. For those seasons, the distribution is from near the coastline to the 4,000-m (13,000-ft) isobath. The areas of concentrated occurrence during spring, summer, and fall are the nearshore waters and waters starting from between the 50- and 100-m (165- and 330-ft) isobaths, over the continental shelf break, to just beyond the 2,000-m (6,600-ft) isobath. Bottlenose dolphins occurring in the proposed Site D USWTR would be from the western North Atlantic offshore stock. The best population estimate for this stock is 81,588 individuals (Waring et al., 2008).
The modeling results show no Level A harassment of bottlenose dolphins would occur. The analysis results show that up to 6,720 incidental exposures of bottlenose dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 6,720 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual bottlenose dolphins experiencing Level B harassment may be fewer than 6,720. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for bottlenose dolphins and would have a negligible impact on this species.

Functional hearing for bottlenose dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007) with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Bottlenose dolphins communicate via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Signature whistles, which identify individual dolphins and are a dominant characteristic of communications between mothers and calves, range from 3.4 to 14.5 kHz, comparable to the 1 to 10 kHz range of mid-frequency active sonar. Potential Level B exposures from mid-frequency active sonar could therefore result in impaired communication between mother and calf pairs. In addition, experiments support the likelihood that some high-frequency active sonar frequencies could result in a behavioral response. Observed changes in behavior in one bottlenose dolphin were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa (DoN, 1997b; Schlundt et al., 2000). Exposure to mid-frequency active sonar that is below or high-frequency active sonar that is above the functional hearing capability of bottlenose dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

In accordance with NEPA, there would be no significant impact to bottlenose dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to bottlenose dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.
Pantropical and Atlantic Spotted Dolphins – Site D

The pantropical spotted dolphin is a deep-water species, and the Atlantic spotted dolphin may occur in both shelf and offshore waters (DoN, 2009g). Atlantic spotted dolphins may occur in continental shelf and offshore waters throughout the VACAPES OPAREA and are expected to occur in the proposed Site D USWTR. The pantropical spotted dolphin may occur seaward of the shelf break throughout the VACAPES OPAREA and in the proposed Site D USWTR. Spotted dolphins occurring in the proposed Site D USWTR would be from the western North Atlantic stocks. In the western North Atlantic, the best abundance estimate for pantropical spotted dolphins is 4,439; for Atlantic spotted dolphins, it is 50,978 (Waring et al., 2008).

The modeling and analysis results estimate no Level A harassment of spotted dolphins. The analysis estimates that up to 3,122 incidental exposures of spotted dolphins (3,041 pantropical and 81 Atlantic) to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 3,122 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual spotted dolphins experiencing Level B harassment may be fewer than 3,122. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy concludes that the proposed action would not affect annual rates of recruitment or survival for all spotted dolphins, and would have a negligible impact on these species.

Functional hearing for pantropical spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Pantropical spotted dolphins communicate, feed and socialize via clicks and whistles at frequency ranges that overlap mid-frequency active sonar though best hearing sensitivity aligns more with that of high frequency sonar. Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995) which overlaps well with mid-frequency active sonar, while clicks are bimodal with peaks at 40 to 60 kHz and 120 to 140 kHz and more aligned with high frequency sonar (Schotten et al., 2004). Potential Level B exposures from mid-frequency active and high frequency sonar could therefore result in impaired communication, changes in foraging and social interaction. However, any behavioral responses are not expected to be long-term due to the likely low received level of acoustic energy and relatively short duration of potential exposures. Thus, interruptions in communication and other activities would be temporary.

Functional hearing for Atlantic spotted dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Atlantic spotted dolphins produce a variety of sounds in frequencies from .1 to above 100 kHz. Whistles range from 7.1 to 14.5 kHz which overlaps with mid-frequency active sonar (1 to 10 kHz) while echolocation clicks ranging from 40 to 130 kHz overlap well with high frequency sonar. Some communication does occur at frequencies below that for mid-frequency active sonar. Exposure to mid-frequency active sonar that is below or high-frequency active sonar that
is above the functional hearing capability of Atlantic spotted dolphins may not elicit a behavioral response since the respective frequencies are outside the functional hearing range of the animal. If the animal does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Given their frequent surfacing, large group size encompassing hundreds of animals (Leatherwood and Reeves, 1982) and probability of trackline detection of 1.00 in Beaufort sea states of 6 or less (Barlow, 2006), lookouts would likely detect both Atlantic and pantropical spotted dolphins at the surface. Implementation of mitigation measures and probability of detection reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Atlantic and pantropical spotted dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to Atlantic and pantropical spotted dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

**Striped Dolphin – Site D**

Striped dolphins are usually found seaward of the continental shelf and are often associated with convergence zones and waters influenced by upwelling. In the VACAPES OPAREA, the striped dolphins’ expected occurrence is at the shelf break and over the continental slope, including in the proposed Site D USWTR. Sightings occur predominantly along the north wall of the Gulf Stream, but not within this current where it travels through the southern portion of the VACAPES OPAREA. Striped dolphins occurring in the proposed Site D USWTR would be from the western North Atlantic stock. The best population estimate for this stock is 94,462 individuals (Waring et al. 2008).

The modeling effort and harassment analysis results show that up to than one incident of Level A harassment of striped dolphins would occur annually. The mitigation measures detailed in Chapter 6 would eliminate this low probability of injurious effect on striped dolphins; therefore, no Level A incidental harassment is anticipated for this species.

The analysis results show that up to 12,318 incidental exposures of striped dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 12,318 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual striped dolphins experiencing Level B harassment may be fewer than 12,318. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for striped dolphins and would have a negligible impact on this species.
Functional hearing for striped dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Kastelein et al., (2003) determined the hearing sensitivity of a single striped dolphin to range from 0.5 to 160 kHz with best sensitivity at 64 kHz. Assuming this study may be applicable to striped dolphins in general, the frequency of best sensitivity for this species is much higher than the range of frequencies for mid-frequency active sonar but aligns well with that of high-frequency active sonar. Dominant frequencies of whistles ranged from 8 to 12.5 kHz (Thomson and Richardson, 1995). The intersection of common frequencies between striped dolphin functional hearing and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Given the gregarious behavior and large group size of up to several hundred or even thousands of animals (Baird et al., 1993), it is likely that lookouts would detect a group of striped dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of striped dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to striped dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to striped dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

**Clymene Dolphin – Site D**

Clymene dolphins are expected in waters seaward of the shelf break south of the northern wall of the Gulf Stream in the VACAPES OPAREA. The Clymene dolphin may occur seaward of the shelf break in the proposed Site D USWTR. Clymene dolphins occurring on the proposed Site D USWTR would be from the western North Atlantic stock. The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring et al., 2008).

The modeling effort and harassment analysis estimates no Level A harassment of Clymene dolphins. The analysis estimates that up to 1,453 incidental exposures of Clymene dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 1,453 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Clymene dolphins experiencing Level B harassment may be fewer than 1,453. Mitigation measures detailed in Chapter 6 would further reduce the potential for any effect on Clymene dolphins. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for Clymene dolphins, and would have a negligible impact on this species.

Functional hearing for Clymene dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in
frequency (range of 6.3 to 19.2 kHz). This frequency range has some overlap with mid-frequency active sonar and aligns well with the lower end of the high-frequency active frequency range.

Given their gregarious behavior and potentially large group size of up to several hundred or even thousands of animals (Jefferson, 2006), it is likely that lookouts would detect a group of Clymene dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Clymene dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Clymene dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to Clymene dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

**Common Dolphin – Site D**

The common dolphin occurs year-round in the VACAPES OPAREA. Winter and spring are the seasons with the most sightings and strandings. Common dolphins are expected to occur during summer through winter from shoreward of the 50-m (165-ft) isobath to outside of the 3,000-m [9,800-ft] isobath. Based on location of sightings, as well the shelf-edge preference of this species, the area of expected occurrence is largest during the spring and narrowest during the winter. From winter through spring, common dolphins are concentrated in the shelf-break region, both inside and seaward of the 200-m (660-ft) isobath. During summer, common dolphins are found in an area of concentrated occurrence in the northeast section of the VACAPES OPAREA, outside of the proposed range site. Common dolphins may occur in the proposed Site D USWTR at any time of year. Individuals found in the proposed Site D USWTR would be from the western North Atlantic stock. The best population estimate for this stock is 120,743 individuals (Waring et al. 2008).

The modeling results and harassment analysis estimate up to nine incidents of Level A harassment of common dolphins annually. The mitigation measures detailed in Chapter 6 would greatly lessen, if not eliminate, this low probability of injurious effect on common dolphins; therefore, no Level A incidental harassment is anticipated for this species.

The analysis estimates that up to 122,541 incidental exposures of common dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 122,541 different individuals. The same common dolphin could be exposed multiple times over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual common dolphins experiencing Level B harassment may be fewer than 122,541. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy, therefore, concludes that the proposed action would not affect annual rates of recruitment or survival for common dolphins and would have a negligible impact on this species.
Functional hearing for common dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). This species’ hearing range extends from 10 to 150 kHz with greatest sensitivity from 60 to 70 kHz (Popov and Klishin, 1998). This species range of best hearing aligns well with high-frequency active sonar frequencies. The intersection of common frequencies between common dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Given the gregarious behavior and large group size of common dolphins (Jefferson et al. 1993), it is likely that lookouts would detect a group of common dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of common dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to common dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to common dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

Risso’s Dolphins – Site D

Risso’s dolphins are most commonly found in areas with steep bottom topography and are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Sightings in the VACAPES OPAREA generally follow this pattern of distribution with patches of occurrence predicted along the path of the Gulf Stream and including steep portions of the continental slope (DoN, 2008m). The Risso’s dolphin is expected to occur in the VACAPES OPAREA and the proposed Site D USWTR year-round. Risso’s dolphins occurring on the proposed Site D USWTR would be from the western North Atlantic stock. The best estimate of Risso’s dolphin abundance in the western North Atlantic is 20,479 individuals (Waring et al., 2008).

The analysis estimates that no Level A harassment of Risso’s dolphins would occur. The analysis results show that up to 2,289 incidental exposures of Risso’s dolphins to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 2,289 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual Risso’s dolphins experiencing Level B harassment may be fewer than 2,289. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for all Risso’s dolphins and would have a negligible impact on this species.

Functional hearing for Risso’s dolphins is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Nachtigall et al.
(1995; 2005) measured hearing in an adult and an infant Risso’s dolphin. The adult hearing ranged from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. The infant could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz, well above mid-frequency active sonar frequencies but well within the high-frequency active sonar frequency range. The intersection of common frequencies between Risso’s dolphin best hearing sensitivity and high-frequency active sonar suggests that more often than not there is a potential for a behavioral response.

Given the frequent surfacing behavior and large group size of Risso’s dolphins (Leatherwood and Reeves, 1982), it is likely that lookouts would detect a group of Risso’s dolphins at the surface. Implementation of mitigation measures and probability of detecting large groups of Risso’s dolphins reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to Risso’s dolphins in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to Risso’s dolphins in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

**Pilot Whales – Site D**

There are two species of pilot whales in the western Atlantic: the Atlantic, or long-finned, pilot whale and the short-finned pilot whale. These species are difficult to identify to the species level at sea; therefore, some of the descriptive material often refers to them collectively. The species boundary is considered to be in the New Jersey to Cape Hatteras area. Both species of pilot whales are expected to occur year-round in waters on the continental shelf, over the shelf break, and into deeper waters past the eastern boundary of the VACAPES OPAREA, including the proposed Site D USWTR. The expected occurrence is assumed to be the same for all seasons. Pilot whales are considered to be shelf-edge species. Pilot whales occurring in the proposed Site D USWTR would be from the western North Atlantic stocks. The best estimate of pilot whale abundance (combined short-finned and long-finned) in the western North Atlantic is 31,139 individuals (Waring et al., 2008).

The modeling results show that no Level A harassment of pilot whales would occur. The analysis results show that up to 3,663 incidental exposures of pilot whales to non-injurious levels of acoustic harassment (Level B harassment) may occur on an annual basis (Table 4.3-11). These exposures would not necessarily occur to 3,663 different individuals. The same individual could experience behavioral disruption more than once over the course of a year, particularly if the animal is resident in the area of the range. Thus, the estimated number of individual pilot whales experiencing Level B harassment may be fewer than 3,663. The actual incidents of behavioral disruption would be reduced beyond these estimates by the mitigation measures presented in Chapter 6. The Navy therefore concludes that the proposed action would not affect annual rates of recruitment or survival for pilot whales and would have a negligible impact on this species.
Functional hearing for pilot whales is estimated to occur between approximately 150 Hz and 160 kHz placing them in the mid-frequency cetacean group (Southall, 2007). Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz. Communication frequencies for pilot whales therefore align well with both mid-frequency active and high-frequency active sonar frequencies. High-frequency active sonar frequencies above 60 kHz may or may not result in a response. If a pilot whale does react to sound outside its functional hearing range, the response may be less severe when compared to the response to a sound that is within the functional hearing range of the animal.

Pilot whale group size typically ranges from several to several hundred individuals (Jefferson et al., 1993). Given the large body size, gregarious behavior, and group size of pilot whales, it is likely that lookouts would detect a group of pilot whales at the surface. Implementation of mitigation measures and probability of detecting groups of pilot whales reduce the likelihood of exposure.

In accordance with NEPA, there would be no significant impact to pilot whales in territorial waters from acoustic effects related to the proposed Site D USWTR. In accordance with EO 12114, there would be no significant harm to pilot whales in non-territorial waters from acoustic effects related to the proposed Site D USWTR.

**Harbor Porpoise – Site D**

The harbor porpoise primarily occurs on the continental shelf in cool temperate to subpolar waters (Read, 1999) that are at higher latitudes than the VACAPES OPAREA (DoN, 2008m). Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP, 1982; Northridge 1996). Intermediate densities of harbor porpoises are found in waters off North Carolina during winter (January through March) (Waring et al., 2007). The harbor porpoise may occur in the VACAPES OPAREA, particularly during winter months, and is expected to occur in the Site D USWTR. Harbor porpoises occurring along the eastern seaboard of the U.S. are from the Gulf of Maine and Bay of Fundy stock. The best estimate of abundance for this stock is 89,054 individuals (Waring et al., 2008).

Insufficient data exist to calculate density estimates for the harbor porpoise in the VACAPES OPAREA. No Level A or Level B exposures are expected for harbor porpoises at the proposed Site D USWTR.

In terms of functional hearing capability, the harbor porpoise belongs to high-frequency cetaceans which have best hearing ranging from 200 Hz to 180 kHz. For sounds produced by this species the dominant frequency range is 110 to 150 kHz (Ketten, 1998; Villadsgaard, 2007), though some echolocation signals include one or two low-frequency components in the 1.4 to 2.5 kHz range (Verboom and Kastelein, 1995). Thus, with the exception of some echolocation signals, most sound production occurs above mid-frequency active sonar frequencies but overlaps well with the upper component of high-frequency active sonar frequencies. High-frequency active sonar frequencies below 110 kHz and above 150 kHz may or may not result in
a response. If the harbor porpoise does react to sound outside their functional hearing range, their response may be less severe when compared to their response to a sound that is within their functional hearing range.

*In accordance with NEPA, there would be no significant impact to harbor porpoises in territorial waters from acoustic effects related to the proposed Site D USWTR.* In accordance with EO 12114, there would be no significant harm to harbor porpoises in non-territorial waters from acoustic effects related to the proposedSite D USWTR.

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### 4.3.10 Aircraft Noise

#### 4.3.10.1 Background on Aircraft Noise

The effects of sounds from fixed-wing and rotary-wing aircraft are discussed in Richardson et al. (1995), and some of the more relevant information from that report is summarized below.

Spectra of radiated noise from helicopters and propeller-driven aircraft generally show multiple tones related to the rotor- or propeller-blade rate and harmonics, with most of the acoustic energy at frequencies below 500 Hz. As would be expected:

- Helicopters are generally noisier than similarly sized fixed-wing aircraft.
- Large aircraft are generally noisier than smaller ones.
- Aircraft on takeoff or in a climb tend to be noisier than when cruising at a relatively stable speed and altitude.

For most cases, aircraft noise must strike the sea surface at a steep angle (within about 13 degrees of the vertical) to enter the water. Underwater sounds from aircraft are strongest below the sea surface directly under the aircraft. The amount of aircraft-generated sound that actually enters the water column depends on the plane’s altitude and in some cases on sea surface swell and wave conditions. The sound level weakens with an increase in aircraft altitude or with an increase in the receiver's (e.g., marine animal) depth.

The sound levels of aircraft noise propagating through the water are greatly affected by water depth and the sea-floor properties. Ambient noise conditions, water depth, and bottom reflectivity also affect the range at which aircraft noise becomes undetectable below the water.

#### 4.3.10.2 Aircraft Noise Effects on Marine Mammals

This subchapter addresses possible harassment of marine mammals by aircraft noise that enters the water. The discussion comes largely from the *Environmental Assessment/Overseas Environmental Assessment of Parametric Airborne Dipping Sonar Helicopter Flight Demonstration Test Program* (DoN, 2000a). This analysis deals with helicopter noise because
helicopters are typically louder than similarly sized fixed-wing aircraft, and operate at a much lower altitude.

There are direct measurements of H-60 series helicopter noise in water as determined in Navy tests (DoN, 1991 as cited in DoN, 2000a). During these tests, an H-60 flew over calibrated sonobuoys and the noise levels were recorded and analyzed. The depth of the sonobuoys was 122 m (400 ft) and the helicopter flew at altitudes ranging from 75 to 1,500 m (246 to 4,291 ft). The test results showed a spectrum dominated by low frequency energy. For the lower altitudes, typical spectrum levels were 72 dB (re 1 μPa/kHz $^{1/2}$) at 100 Hz, 60 dB at 500 Hz, 56 dB at 1 kHz, and 28 dB at 5 kHz. Total SPL for the low to medium altitudes was about 100 dB re 1 μPa.

Propagation of acoustic energy from air into water is a much-studied phenomenon and can be reliably modeled using a number of techniques (e.g., Gerjuoy, 1948; Young, 1971; Medwin et al., 1973, all as cited in DoN, 2000a). Starting with the measured SPL in water and the aircraft altitude at the time, models yield source levels for the helicopter of about 150 dB (re 1 μPa at 1 m). This source level is consistent with measured helicopter-radiated noise levels in air. Aircraft source levels are almost always frequency-weighted and referenced to 20 μPa. In that case, the H-60 source level would be about 124 dB(A) at 1 m (3.3 ft).

For this source level, the same model can then be used to determine the sound levels at various depths of interest (i.e., possible animal depths) for helicopter altitudes of interest. Table 4.3-12 shows these sound levels directly below the aircraft.

```
Table 4.3-12

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Source Level (at 1 m [3.3 ft] from helicopter)</th>
<th>Depth = 1 m (3.3 ft)</th>
<th>Depth = 122 m (400 ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 m</td>
<td>150 dB</td>
<td>130 dB</td>
<td>101 dB</td>
</tr>
<tr>
<td>76 m</td>
<td>150 dB</td>
<td>119 dB</td>
<td>100 dB</td>
</tr>
</tbody>
</table>
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The 100 dB level for the 76-m (249-ft) altitude and the 122-m (400-ft) sonobuoy depth is displayed to show agreement with the H-60 measurement described above. The 122-m (400-ft) depth is about the same (101 dB) for the 15-m (49-ft) altitude, and most other altitudes of interest. (A simplified model, as discussed in references given above, for propagation of noise from air to a point directly below in water puts a virtual source at one-fifth the altitude and then propagates from there as if in water, with dipole directivity and 7 dB reduction in source level. Hence, the propagation paths for the two altitudes to the 122-m [400-ft] depth are about 125 m [410 ft] and 137 m [450 ft]. The difference in spherical spreading loss is about 0.8 dB).

The maximum in each case is for the level at the surface (labeled here as 1 m [3.3 ft]). For an SH-60F helicopter altitude of 15 m (49 ft), the estimated noise level directly below the aircraft is
130 dB. The level is lower for receiving points farther away from the source (in depth and/or in range). Note that for noise generated in air, the SPL near the air-sea interface is about the same in air as in water (actually 6 dB higher level in water).

For a maximum SPL of 130 dB re 1 μPa in water, total SEL in water is bounded by

\[
SEL \ (\text{dB re } 1 \ \mu \text{Pa}^2\text{-s}) \leq 130 + 10 \log T
\]

where T is exposure time in seconds.

It is apparent that an animal would have to be exposed for a very long time period (e.g., 3x10^6 seconds, or about 878 hours) to accumulate enough energy to approach the SEL TTS threshold of 195 dB re 1 μPa2s, and based on spherical spreading the receive level will attenuate to below 120 dB re 1 μPa in approximately 3 m. It is unlikely that exposure time for any given animal during the proposed training exercises could exceed an hour (given aircraft hover time and animal motion). Hence, it is concluded that there is negligible risk from helicopter noise and, therefore, there would also be negligible risk from other aircraft noise.

There is potential for behavioral response below 195 dB re 1 μPa^2-s. Studies have shown that the presence of an aircraft, both helicopters and fixed wing aircraft, may elicit a response in marine mammals as the aircraft flies overhead. For example, a review by Smultea et al. (2008) found that sperm whale behavior related to aircraft overflight ranges from apathetic to avoidance to defensive. Some individuals or groups did not appear to notice aircraft. Those that did seem to react to the presence of an airplane or helicopter either changed their surface behavior (abrupt change in swimming direction, increased respiration, decreased surface interval) or dove. At least two of the studies reviewed by Smultea et al. (2008) observed what is presumed to be defensive behavior (closing of distance between individuals and formation of a semi-circle at the water’s surface). Generally, when there was a reaction to aircraft overflight it was within approximately 300 m lateral distance from the aircraft at low altitude and often there was a direct agitation of the water in the vicinity of the animals due to down-draft from the aircraft. The studies in which these reactions were observed were aimed at observing and identifying the animals, and thus stayed in the vicinity of the groups observed (including circling overhead) for several minutes. Navy aircraft would likely pass through an area more quickly than this; it is possible that marine mammals may startle and dive in reaction to the sound of an aircraft or due to the visual detection of overflight (such as a shadow on the surface of the water), but the noise produced by aircraft overflight would have little or no effect on marine mammals at the water’s surface.

Hence, it is concluded that there is negligible risk from helicopter noise and, therefore, there would also be negligible risk from other aircraft noise.
4.3.10.3 Aircraft Noise Effects on Sea Turtles

Approximately 115 helicopter sorties would occur in the Northeastern Florida Action Area annually under the Preferred Alternative. Helicopter overflights can occur throughout the Northeastern Florida Action Area. Unlike fixed-wing aircraft, helicopter training operations often occur at low altitudes (zero to 2,500 ft).

Based on results of a comprehensive literature review, no information regarding sea turtle reactions to helicopter overflights is available. However, based on knowledge of turtle auditory capabilities (Lenhardt 1994, Bartol et al. 1999, Ridgway 1969, Bartol and Musick 2003; Bartol et al. 2002; Levenson et al. 2004), as well as their response to visual cues (Hazel et al. 2007) discussed in the fixed-wing aircraft overflights section, it is reasonable to assume that if exposed, sea turtles may react to helicopter overflights. Animals would only be exposed to the sound and water disturbance if they are at or near the water surface. The sound exposure levels would be relatively low to sea turtles since they spend the majority of their time underwater. In addition to the auditory and visual cues, animals may react to the disturbance of the water by the downdraft. Sea turtles exposed to low-altitude helicopter overflights under the Preferred Alternative could exhibit a short-term behavioral response, but these reactions would not permanently displace animals or result in physical harm. Therefore, helicopter overflights under the Preferred Alternative may affect sea turtles. However, helicopter overflights are not expected to result in chronic stress because it is extremely unlikely that individual animals would be repeatedly exposed.

4.3.10.4 Aircraft Noise Effects on Fish

This subchapter addresses possible harassment of fish by aircraft noise that enters the water. The information on aircraft noise levels reported in the previous section (Section 4.3.10.2 Aircraft Noise Effects on Marine Mammals) is applicable to this section as well.

Richardson et al. (1995) reported that the duration of audibility of a passing aircraft is quite variable. Sounds from approaching aircraft are detectable far longer in air than in water. Richardson et al. (1995) gave an example of a Bell 214ST helicopter (a noisy model) as being audible in air for over four minutes before it passed hydrophones, but was detectable underwater for only 38 seconds at a 3-m (9.8-ft) depth and 11 seconds at an 18-m (36-ft) depth (Greene 1985).

Considering Richardson et al.’s (1995) work, any effects as a result of exposure to sounds from aircraft transiting to the USWTR site would occur for a very brief amount of time (assuming mortality is not an effect). In the USWTR site, however, a helicopter may hover, therefore increasing the length of sound exposure. As reported in the previous section, 130 dB re 1 µPa at a depth of 1 m is the maximum expected SPL generated by an H-60 helicopter. At deeper depths and for higher flying aircraft, the sound level is diminished. Luczkovich and others (1999) reported weakfish individuals call at 127 dB re 1 µPa and sound levels of an aggregation of weakfish and other fish producing sounds can reach levels of 147 dB re 1 µPa. Therefore, it is
not expected that physical damage would be caused to fish due to aircraft noise because the SPL of aircraft is not greater than the SPL of the fish sounds themselves (assuming other species of fish experience no harm when exposed to weakfish calls).

Still, there is a potential to mask important ecological sounds of fish in the USWTR area. Masking occurs when one sound is louder than a second sound of importance to the receiver. One of the most important sounds for some fish is that of reproductive calling. Some soniferous (sound producing) fishes, largely the sciaenids (drums), spawn inshore of the USWTR areas, while others spawn offshore overlapping the more shallow depths of the USWTR site. Associated congregations of inshore soniferous fishes have been found to produce loud, nocturnal “choruses” during spawning season (Fish and Mowbray, 1970). Choruses related to spawning primarily occur from dusk to dawn, which limits the potential for aircraft noise to mask reproductive calling. Moreover, spawning choruses tend to be higher pitched, with frequencies between 1 and 2 kHz, than that of general fish sounds (croaks, groans) which are usually centered below 500 Hz (Fish and Mowbray, 1970). Thus, the low frequencies of helicopter noise are not likely to mask the higher pitched frequencies of spawning choruses.

Other ecologically important sounds include those of predator avoidance and prey detection. Aircraft noise is within the frequencies of these sounds. The potential to mask these other ecologically important sounds is insignificant on a population level given the limited area over the ocean’s surface a sound can enter the water from an aircraft (within about 13 degrees of the vertical) and the limited amount of time an aircraft will hover or be in transit.

4.3.11 Potential Effects of Ship Noise on Marine Mammals

Increased numbers of ships operating in the area will result in increased sound from vessel traffic. Marine mammals react to vessel-generated sounds in a variety of ways. Some respond negatively by retreating or engaging in antagonistic responses while other animals ignore the stimulus altogether (Watkins, 1986; Terhune, 1999).

Most studies have ascertained the short-term response to vessel sound and vessel traffic (Watkins et al., 1981; Baker et al., 1983; Magalhães et al., 2002); however, the long-term implications of ship sound on marine mammals are largely unknown (NMFS, 2007h).

 Anthropogenic sound has increased in the marine environment over the past 50 years (W.J. Richardson et al., 1995, NRC 2003). This sound increase can be attributed to increases in vessel traffic as well as sound from marine dredging and construction, oil and gas drilling, geophysical surveys, sonar, and underwater explosions (W.J. Richardson et al., 1995).

Given the current ambient sound levels in the marine environment, the amount of sound contributed by the use of Navy vessels in the proposed exercises is very low. It is anticipated that
any marine mammals exposed may exhibit only short-term reactions and would not suffer any long-term consequences from ship sound.

4.3.12 Potential Effects of Ship Noise on Sea Turtles

The ability of turtles to detect approaching water vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology (Bartol and Musick 2003; Levenson et al. 2004; Ketten and Bartol 2006; Moein Bartol and Ketten 2006). 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. Hazel et al. (2007) also found that sea turtles reacted to approaching vessels in a variety of ways. 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 hearing sensitivity is not well studied. Several studies using green, loggerhead, and Kemp’s ridley turtles suggest sea turtles are most sensitive to low-frequency sounds, although this sensitivity varies slightly by species and age class (Ridgway et al. 1969; Lenhardt et al. 1994; Bartol 1999; Ketten and Bartol 2006). 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 1999; Ketten and 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.

Given the current ambient sound levels in the marine environment, the amount of sound contributed by the use of Navy vessels in the proposed exercises is very low. It is anticipated that any sea turtles exposed would exhibit only short-term reactions and would not suffer and long-term consequences from ship sound.

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 very 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). For turtles, this can include intense behavioral reactions such as biting and rapid flipper movement (Gregory and Schmid 2001). In the short term exposure to stressors result in changes in immediate behavior (Frid 2003). 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. In individual bottlenose dolphins, chronic
stress due to physical injury or disease resulted in morphological changes to the adrenal glands (Clark et al. 2006). Although this study related to natural induced stressors, similar physiological changes may result from other types of stressors such as anthropogenic disturbance.

Chronic stress can result in decreased reproductive success (Lordi et al. 2000; Beale and Monaghan 2004), decreased energy budget (Frid 2003), displacement from habitat (Sutherland and Crockford 1993), and lower survival rates of offspring (Lordi et al. 2000). At this time, it is unknown what the long-term implications of chronic stress may be on sea turtle species.

Sea turtles may become habituated to sounds, including high levels of ambient noise found in areas of high vessel traffic (Moein et al. 1994; Hazel et al. 2007). Moein, et al. (1994) conducted a study using a fixed sound source to repel sea turtles away from hopper dredges. Three decibel levels (175, 177, and 179 dB re 1 μPa at 1 m) were used for the study. It was found that while sea turtles avoided the sound upon first exposure, they appeared to habituate to the stimuli over a period of time (Lenhardt 1994; Moein et al. 1994). Adult loggerheads have been observed to initially respond (i.e., increase swimming speeds) and avoid air guns when received levels range from 151 to 175 dB re: 1 μPa, but they eventually habituate to these sounds (Lenhardt 2002).

One turtle in the study did exhibit TTS for up to two weeks after exposure to these levels (Lenhardt 2002). Sea turtles exposed to the general disturbance associated with a passing Navy vessel could exhibit a short-term behavioral response such as fleeing. Therefore, general vessel disturbance under the Preferred Alternative may affect ESA-listed sea turtles.

4.3.13 Potential Effects of Active Military Sonar Systems on Fish

Popper (DoN, 2008p) presents a technical review and analysis of what is known and not known about the effects of MFA and HFA sonar on fish. The following text provides a summary of the conclusions presented in that technical report.

The data obtained to date on effects of sound on fish are very limited both in terms of number of well-controlled studies and in number of species tested. Moreover, there are significant limits in the range of data available for any particular type of sound source. Finally, most of the data currently available has little to do with actual behavior of fish in response to sound in their normal environment. There is almost nothing known about stress effects of any kind(s) of sound on fish.

Mortality and Damage to Non-auditory Tissues

The results of studies conducted to date show only the most limited mortality, and then only when fish are very close to an intense sound source. Thus, whereas there is evidence that fish within a few meters of a pile driving operation will potentially be killed, very limited data (and data from poorly designed experiments) suggest that fish further from the source are not killed, and may not be harmed. It should be noted, however, that these and other studies showing
mortality (to any sound source) need to be extended and replicated in order to understand the effects of the most intense sound on fish.

It is also becoming a bit clearer from the studies discussed in Subchapter 3.3.1.2 (again, albeit from very few studies) that those species of fish tested at a distance from the source where the sound level is below source level, show no mortality and possibly no long-term effects. Of course, it is recognized that it is very difficult to extrapolate from the data available (e.g., Popper et al., 2005, 2007) since only a few sound types have been tested, and even within a single sound type there have to be questions about effects of multiple exposures and duration of exposure. Still, the results to date are of considerable interest and importance, and clearly show that exposure to many types of loud sounds may have little or no effect on fish.

**Effects on Fish Behavior**

The more critical issue, however, is the effect of human-generated sound on the behavior of wild animals, and whether exposure to the sounds will alter the behavior of fish in a manner that will affect its way of living – such as where it tries to find food or how well it can find a mate. With the exception of just a few field studies (e.g., Wilson and Dill, 2002; Mann et al., 2005), there are no data on behavioral effects, and most of these studies are very limited in scope and all are related to seismic airguns. Because of the limited ways in which behavior of fish in these studies were “observed” (often by doing catch rates, which tell nothing about how fish really react to a sound), there really are no data on the most critical questions regarding behavior.

Indeed, the fundamental questions are how fish behave during and after exposure to a sound as compared to their “normal” pre-exposure behavior. This requires observations of a large number of animals over a large area for a considerable period of time before and after exposure to sound sources, as well as during exposure. Only with such data is it possible to tell how sounds affect overall behavior (including movement) of animals.

**Increased Background Sound**

In addition to questions about how fish movements change in response to sounds, there are also questions as to whether any increase in background sound has an effect on more subtle aspects of behavior, such as the ability of a fish to hear a potential mate or predator, or to glean information about its general environment. There is a body of literature that shows that the sound detection ability of fish can be “masked” by the presence of other sounds within the range of hearing of the fish (e.g., McCauley et al. 2003; Amoser and Ladich, 2003; M.E. Smith, et al., 2004a, b; Wysocki and Ladich, 2005). Just as a human has trouble hearing another person as the room they are in gets noisier, it is likely that the same effect occurs for fish (as well as all other animals). In effect, acoustic communication and orientation of fish may potentially be restricted by noise regimes in their environment that are within the hearing range of the fish.

While it is possible to suggest behavioral effects on fish, there have been few laboratory, and no field, studies to show the nature of any effects of increased background noise on fish behavior.
At the same time, it is clear from the literature on masking in fish, as for other vertebrates, that the major effect on hearing is when the added sound is within the hearing range of the animal. Moreover, the bulk of the masking effect is at frequencies around that of the masker. Thus, a 2 kHz masker will only mask detection of sounds around 2 kHz, and a 500 Hz masker will primarily impact hearing in a band around 500 Hz.

As a consequence, if there is a background sound of 2 kHz, as might be expected from some MFA sonars, and the fish in question does not hear at that frequency, there will be no masking, and no affect on any kind of behavior. Moreover, since the bulk of fish communication sounds are well below 1 kHz (e.g., Zelick et al., 1999), even if a fish is exposed to a 2 kHz masker which affects hearing at around 2 kHz, detection of biologically relevant sounds (e.g., of mates) will not be masked.

Indeed, many of the human-generated sounds in the marine environment are outside the detection range of most species of marine fish studied to date (see Table 3.3-1). In particular, it appears that the majority of marine species have hearing ranges that are well below the frequencies of the mid- and high-frequency range of the operational sonars used in Navy exercises, and therefore, the sound sources do not have the potential to mask key environmental sounds. The few fish species that have been shown to be able to detect mid- and high-frequencies, such as the clupeids (herrings, shads, and relatives), do not have their best sensitivities in the range of the operational sonars. Additionally, vocal marine fish largely communicate below the range of mid- and high-frequency levels used in Navy exercises.

Implications of Temporary Reduction in hearing sensitivity (TTS)

Another related issue is the impact of temporary reduction in hearing sensitivity, referred to as temporary threshold shift (TTS), on fish. This effect has been demonstrated in several fish species where investigators used exposure to either long-term increased background levels (e.g., M.E. Smith et al., 2004a) or intense, but short-term, sounds (e.g., Popper et al., 2005), as discussed above. At the same time, there is no evidence of permanent reduction in hearing sensitivity (e.g., deafness), often referred to in the mammalian literature as permanent threshold shift (PTS), in fish. Indeed, unlike in mammals where deafness often occurs as a result of the death and thus permanent loss of sensory hair cells, sensory hair cells of the ear in fish are replaced after they are damaged or killed (Lombarte et al., 1993; M.E. Smith et al., 2006). As a consequence, any reduction in hearing sensitivity in fish may be as temporary as the time course needed to repair or replace the sensory cells that were damaged or destroyed (e.g., M.E. Smith et al., 2006).

TTS in fish, as in mammals, is defined as a recoverable reduction in hearing sensitivity. Generally there is recovery to normal hearing levels, but the time-course for recovery depends on the intensity and duration of the TTS-evoking signal. There are no data that allows one to “model” expected TTS in fish for different signals, and developing such a model will require far more data than currently available. Moreover, the data would have to be from a large number of fish species since there is so much variability in hearing capabilities and in auditory structure.
A fundamentally critical question regarding TTS is how much the temporary loss of hearing would impact survival of fish. During a period of reduction in hearing sensitivity, fish will potentially be less sensitive to sounds produced by predators or prey, or to other acoustic information about their environment. The question then becomes how much TTS is behaviorally significant for survival. However, there have yet to be any studies that examine this issue.

Most marine fish species are hearing generalists and so cannot hear MFA and HFA sonar. Thus, there is little or no likelihood of there being TTS as a result of exposure to these sonars, or any other source above 1.5 kHz. It is possible that MFA sonars are detectable by some hearing specialists such as a number of sciaenid species and clupeids. However, the likelihood of TTS in these species is small since the duration of exposure of animals to a moving source is probably very low since exposure to a maximum sound level (generally well below the source level) would only be for a few seconds as the navy vessel moves by.

**Stress**

While the major questions on effects of sound relate to behavior of fish in the wild, a more subtle issue is whether the sounds potentially affect the animal through increased stress. In effect, even when there are no apparent direct effects on fish as manifest by reduction in hearing sensitivity, tissue damage, or changes in behavior, it is possible that there are more subtle effects on the endocrine or immune systems that could, over a long period of time, decrease the survival or reproductive success of animals. While there have been a few studies that have looked at things such as cortisol levels in response to sound, these studies have been very limited in scope and in species studied.

**Eggs and Larvae**

Finally, while eggs and larvae must be of concern, the few studies of the effects of sounds on eggs and larvae do not lead to any conclusions with how sound would impact survival. And of the few potentially useful studies, most were done with sources that are very different than sonar. Instead, they employed seismic airguns or mechanical shock. While a few results suggest some potential effects on eggs and larvae, such studies need to be replicated and designed to ask direct questions about whether sounds, and particularly mid- and high-frequency sounds, would have any potential impact on eggs and larvae.

**General Conclusions**

As discussed by Popper (DoN, 2008p), the extent of data, and particularly scientifically peer-reviewed data, on the effects of high intensity sounds on fish is exceedingly limited. At the same time, in considering potential sources that are in the mid- and high-frequency range, a number of potential effects are clearly eliminated. Most significantly, since the vast majority of fish species studied to date are hearing generalists and cannot hear sounds above 500 to 1,500 Hz (depending
upon the species), there are not likely to be behavioral effects on these species from higher frequency sounds.

Moreover, even those marine species that may hear above 1.5 kHz, such as a few sciaenids and the clupeids (and relatives), have relatively poor hearing above 1.5 kHz as compared to their hearing sensitivity at lower frequencies. Thus, it is reasonable to suggest that even among the species that have hearing ranges that overlap with some mid- and high-frequency sounds, it is likely that the fish will only actually hear the sounds if the fish and source are very close to one another. Finally, since the vast majority of sounds that are of biological relevance to fish are below 1 kHz (e.g., Zelick et al., 1999; Ladich and Popper, 2004), even if a fish detects a mid- or high-frequency sound, these sounds will not mask detection of lower frequency biologically relevant sounds. Thus, a reasonable conclusion, even without more data, is that there will be few, and more likely no, impacts on the behavior of fish.

It is possible that very intense mid- and high-frequency signals, and particularly explosives, could have a physical impact on fish, resulting in damage to the swim bladder and other organ systems. However, even these kinds of effects have only been shown in a few cases in response to explosives, and only when the fish has been very close to the source. Such effects have never been shown to any Navy sonar. Moreover, at greater distances (the distance clearly would depend on the intensity of the signal from the source), there appears to be little or no impact on fish, and particularly no impact on fish that do not have a swim bladder or other air bubble that would be affected by rapid pressure changes.

Based on the evaluation presented by Popper (DoN, 2008p), the likelihood of significant effects to individual fish from active sonar is low. Therefore, there will be no significant impact to fish populations as a result of active sonar activities at any of the four USWTR sites (A, B, C, and D).

### 4.3.14 Potential Effects of Active Military Sonar Systems on Human Divers

Due to the distance from shore and the depth of the range, it is unlikely that recreational or commercial divers would be present in the USWTR area. As discussed in Subchapter 4.1, the Professional Association of Diving Instructors (PADI) suggests that recreational divers should not exceed 40 m (130 ft) (PADI, 2006). Diving beyond these depths is considered technical diving, which typically requires one or more mandatory decompression stops during ascension (NOAA Ocean Explorer, 2008). The overall safety risks associated with technical dives and the equipment required to conduct these types of dives greatly restricts its implementation. However, even if recreational or commercial divers were present, the potential for effects on them from active sonar transmissions within the USWTR would be negligible, because Navy training exercises would not be conducted close enough to them to exceed permissible exposure limits (PELs).
USWTR operational activities would be required to avoid scuba divers and their boats. Because of the distance from shore, a diving support vessel would be in attendance of any divers on the range. Navy shipboard lookouts would be used at all times during the exercise and would spot the diving support vessels. Separate from any concern about acoustic impacts on divers, this is a matter of routine and prudent ship handling to ensure that Navy ships and any diver support ships remain clear of each other. Further, when exercise torpedoes (non-explosive) would be used, there would be clearance zones where portions of the range would be closed for torpedo launches. Civilian diving activities within the exercise areas could require delays, interruptions, or alterations of training exercises. The Navy would implement an Outreach Plan to avoid any potential overlaps with civilian ships (see Chapter 6).

Appendix 1A, Safe Diving Distances from Transmitting Sonar, of the *U.S. Navy Diving Manual* (DoN, 2008q) is the Navy’s governing document for human divers in relation to MFA sonar systems. That appendix provides procedures for calculating safe distances from active sonars. Such procedures are derived from experimental and theoretical research conducted at the Naval Submarine Medical Research Laboratory and the Naval Experimental Diving Unit. Inputs to those procedures include diver dress, type of sonar, and distance from the sonar. The output is represented as a PEL (i.e., how long the diver can safely stay at that exposure level). For example, a diver wearing a wetsuit without a hood has a PEL of 71 minutes at a distance of 914 m (3,000 ft) from the AN/SQS-53 sonar. That same appendix advises that if the type of sonar is unknown, divers should start 550 to 2,740 m (1,800 to 9,000 ft), depending on diving equipment, from the source and move closer (as needed) to the limits of diver comfort. The probability of physiological damage increases markedly as the received sound pressures increase beyond 200 dB at any frequency (DoN, 2008q). Exposure of divers to levels above 200 dB is prohibited unless full wet suits and hoods are worn. Fully protected divers (full wet suits and hoods) must not be exposed to SPLs in excess of 215 dB at any frequency for any reason. By following Navy guidance, the potential for effects on divers would be negligible.
4.4 Socioeconomic Environment

This chapter discusses the socioeconomic impacts of constructing and operating an instrumented USWTR in the Jacksonville, Charleston, Cherry Point, or VACAPES OPAREAAs. Specifically, impacts on federal agency usage, commercial fishing, recreational fishing, commercial shipping, recreational boating, and scuba diving are detailed. Upon installation of the range instrumentation, and for the life of the range, no other structures, such as artificial reefs, wind farms, or oil or gas platforms, would be allowed to be constructed within the range. This is because such structures would not be compatible with the operation of the range, due to the possibility of damage to the range instrumentation.

The potential impacts at Sites A, B, C, and D are discussed together, since impacts are anticipated to be similar at the four sites. Differences that may exist between sites are discussed in each subchapter.

As discussed in Subchapter 2.3, if the Navy does not construct the USWTR, it would continue training exercises on the existing ranges. It would also continue its present practice of conducting training in uninstrumented shallow water operational areas that have been established along the east coast. As the No Action Alternative would comprise the continuation of current Navy practices, it would not result in any socioeconomic impacts.

4.4.1 Federal Agency Usage

4.4.1.1 Site A

The Jacksonville OPAREA is a major area of federal agency usage, primarily by the Navy. FACSFAC Jacksonville would centrally coordinate Site A utilization to avoid conflicts in the Jacksonville region. Therefore, a USWTR at Site A would not have significant negative effects on federal agency usage in the vicinity of the range.

4.4.1.2 Site B

The Charleston OPAREA is a major area of federal agency usage, primarily by the Navy. FACSFAC Jacksonville would centrally coordinate Site B utilization to avoid conflicts in the Charleston region. Therefore, a USWTR at Site B would not have significant negative effects on federal agency usage in the vicinity of the range.

4.4.1.3 Site C

The Cherry Point OPAREA is a major area of military usage, primarily by the Navy. FACSFAC VACAPES would centrally coordinate Site C USWTR utilization to avoid conflicts with federal agency operations in the Cherry Point region. Therefore, a USWTR at Site C would not have significant negative effects on federal agency usage in the vicinity of the range.
4.4.1.4 Site D

Similar to the Cherry Point OPAREA, the VACAPES OPAREA is a major area of federal agency usage. The Mid-Atlantic Test Range Warning Area is some portion of W-386 configured to suit whatever event WFF is currently conducting; therefore, the positions of the boundaries of the warning area vary. Permission to use portions of W-386 is gained through WFF’s coordination and cooperation with FACSFAC VACAPES. FACSFAC VACAPES would centrally coordinate Site D USWTR utilization to avoid conflicts to the maximum extent possible between federal agency operations in the VACAPES region.

A USWTR at Site D would increase Navy use of operational areas used by the NASA WFF for sub-orbital and orbital rocket missions and uninhabited aerial vehicle missions. Potential schedule impacts to NASA missions may result in increased mission costs due to mission delays, expenditures for overtime pay, and re-fly attempts (John H. Campbell, Director of Suborbital and Special Orbital Projects, WFF, letter, February 22, 2006). For commercial flight services, additional mission costs may result from the need for the commercial vehicle providers to insure themselves against potential destruction of the USWTR underwater equipment. Loss of schedulable time and flexibility also may require the cancellation of some WFF missions (John H. Campbell, Director of Suborbital and Special Orbital Projects, WFF, letter, February 22, 2006).

The WFF has stated its concern that a USWTR at Site D would unacceptably impact the facility’s range operations (John H. Campbell, Director of Suborbital and Special Orbital Projects, WFF, letter, February 22, 2006). Based on a metric of 161 days of USWTR use annually, WFF estimates that 61% of the facility’s available working days (Monday through Friday) would be impacted due to nonavailability of the offshore warning area. In addition, WFF contends that days available for facility missions would be further curtailed were the Navy to reschedule events on the USWTR due to adverse weather (John H. Campbell, Director of Suborbital and Special Orbital Projects, WFF, letter, February 22, 2006).

As described in Subchapter 2.2.2.1, 161 ASW training events would occur on the range each year (Table 2-3). On any given day, more than one training event may occur simultaneously on the USWTR; therefore, the range would be used for ASW training for 80 to 130 days out of the year (K.B. Baragar, Deputy Director, Fleet Training, U.S. Fleet Forces Command, letter, April 20, 2006). ASW training events on the USWTR and WFF rocket launches and uninhabited aerial vehicle flights often would not be impacted similarly by weather; therefore, the Navy anticipates that some training events would proceed on the USWTR on days when adverse weather precludes WFF launches and flights. Therefore, the Navy believes that the WFF’s characterization of 161 events on the USWTR impacting 61% of test days available annually to the facility overstates the potential impacts (K.B. Baragar, Deputy Director, Fleet Training, U.S. Fleet Forces Command, letter, April 20, 2006) and the actual impact to the WFF’s available working days would be substantially less.


4.4.2 Commercial Fishing

4.4.2.1 Fishery Stocks

As discussed in Subchapter 4.2, there would be no significant effects to fish populations or EFH with construction or operation of the proposed USWTR. Therefore, no impact on fishery stocks is expected.

4.4.2.2 Fishing Activity

As discussed in Subchapter 3.4, many commercial fishery species are fished over areas of bottom relief, such as canyons, outcroppings, rock rubble, artificial reefs, and shipwrecks. These can be very similar to the popular areas used by recreational fishermen and are considered to be fish havens (DoN, 2008l, m, n). As shown on Figure 3.4-2, five known popular fishing locations occur within the proposed Site A USWTR. Figure 3.4-3, shows ten such locations within the Site B USWTR, and in Figure 3.4-4, ten known popular fishing locations are shown within the proposed Site C USWTR. Finally, there are seven such locations in the proposed Site D USWTR (Figure 3.4-8).

As necessary, prior to conducting exercises within the USWTR, the Navy may issue notices to mariners (NOTMARs), which are notices to ships and submarines issued as advisories of potentially hazardous operations. If issued, NOTMARs would be promulgated 72 hours prior to hazardous operations. Additionally, notices to airmen (NOTAMs), which are comparable notices to aircraft may be issued if necessary. The presence of commercial or recreational vessels and/or aircraft could delay, interrupt, or require alteration of DoN training exercises, decreasing training efficiency. A delay or immediate hold on the exercise would be considered if any commercial fishing or other vessel entered the operations area within the range without prior notification or warning.

4.4.2.3 Fishing Vessels and Gear

Interaction with USWTR Infrastructure

As described in Chapter 2, the major in-water components for the proposed USWTR are:

- Transducer nodes measuring 254 cm (100 in) in diameter, 122 cm (48 in) high, and 3,630 kg (8,000 lbs) in weight.
- Fiber-optic undersea cables between nodes with breaking strengths of over 9,070 kg (20,000 lbs).
A buried fiber-optic trunk cable connecting range sensors to the shore facility, with a breaking strength of over 13,610 kg (30,000 lbs).

A junction box interconnecting the various cable types, measuring approximately 3 m (10 ft) square and weighing about 1,500 kg (700 lbs).

Fishing activities have the potential to interact with the proposed USWTR transducer nodes and other infrastructure. Commercial bottom fishing activities, such as bottom trawling, scallop dredging, and clam dredging, have the greatest potential for negative effects. Bottom-dragged gear, such as bottom trawls, dredges, and anchors, could displace or damage transducer node mounts and interconnect cables, potentially disrupting the operation of the transducer nodes. Interactions between bottom-fishing gear and USWTR infrastructure also could result in damage to or the loss of fishing gear.

However, the overall shape and configuration of transducer nodes would be designed to be consistent with local geographic conditions and to accommodate area activities such as fishing. Due to the low sensor profile above the ocean bottom, there is little potential for interaction with fishing gear in the water column, such as long lines or suspended nets. Anchoring activity also has some potential for negative interaction. Because the USWTR trunk cable would be buried (up to 1 m [3 ft] in soft bottom and trenched about 30 cm [1 ft] in hard bottom), it is anticipated that there would be little potential interaction between the trunk cable and fishing gear, including bottom equipment. In addition, the shallower portions of the interconnect cables may be buried to minimize interaction with bottom fishing gear.

Fishing Activities and Interaction with Inert Materials

This discussion on the potential for fishing activities to interact with expended materials on the range is applicable to the four proposed USWTR sites, A, B, C, and D.

Various inert materials would be utilized in the USWTR. Some inert materials would not be recovered and would be expended materials on the range. Such expended inert materials may include torpedo control wires and flex hoses, XBTs, sonobuoys, ADCs, and EMATTs, as discussed in Subchapter 4.1. All inert materials would sink to the bottom; none would float or be suspended in the water column.

Fishing activities have the potential to interact with expended materials on the range. Damage to or loss of fishing gear could result from the inadvertent capture and retrieval of expended materials, or entanglement of fishing gear with expended materials.

4.4.3 Recreational Fishing

As described in Subchapter 3.4, recreational or sport fishing is popular in the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs. Figures 3.4-2, 3.4-3, 3.4-4, and 3.4-8
identify the popular fishing areas in all four OPAREAs. Five such locations are known to be within the proposed Site A USWTR, ten are within the proposed Site B, ten are in the proposed Site C, and seven are in the proposed Site D. As previously described, prior to conducting exercises within the USWTR, the DoN may issue notices to mariners or other public notices, which are notices to ships issued as advisories of potentially hazardous operations. If issued, notices to mariners would be promulgated 72 hours prior to hazardous operations.

4.4.3.1 Site A

Both private and charter recreational bottom fishing vessels target hard bottom and artificial reefs. The artificial reef closest to the proposed Site A USWTR is situated to the west of the proposed site; the distance between the site and the reef is approximately 10 km (5 NM). Recreational fishermen also target pelagic species that can be associated with bottom features or with oceanographic features. Floating mats of *Sargassum* also attract pelagic game fish species, and these mats would most likely be present on some part of the proposed Site A USWTR during all parts of the year.

4.4.3.2 Site B

Recreational bottom fishing vessels off of the South Carolina coast target bottom structures and artificial reefs. The Savannah lithoherms, an area of substantial deep sea coral habitat, occurs seaward of the proposed Site B USWTR; the extreme southeast corner of the proposed range overlaps the habitat. The artificial reef closest to the proposed Site B USWTR is situated to the north of the proposed site; the distance between the site and the reef is approximately 19 km (10 NM). Recreational fishermen also target pelagic species. Pelagic fish can be associated with bottom features, oceanographic features, or floating mats of *Sargassum*. Mats of *Sargassum* would most likely be present on some part of the proposed Site B USWTR during all parts of the year.

4.4.3.3 Site C

Recreational bottom fishing vessels are concentrated near artificial reefs, hard bottom, shipwrecks and other bottom features (DoN, 2008l). The three artificial reefs closest to the proposed Site C USWTR are situated to the north of the proposed site; distances between the site and the reefs range between approximately 25 and 35 km (13 and 19 NM). Hard bottom is located throughout proposed Site C. Recreational fishermen also target pelagic species that can be associated with bottom features or with oceanographic features. Floating mats of *Sargassum* also attract pelagic game fish species, and these mats would most likely be present on some part of the proposed Site C USWTR during all parts of the year. Fishermen will target these *Sargassum* mats.
4.4.3.4 Site D

Recreational bottom fishing vessels off of the Virginia-Maryland coast target bottom structures and artificial reefs. The three artificial reefs closest to the proposed Site D USWTR are situated to the west of the proposed site; distances between the site and the reefs range between approximately 65 and 95 km (35 and 51 NM). Recreational fishermen also target pelagic species. Pelagic fish can be associated with bottom features, oceanographic features, or floating mats of *Sargassum*. Mats of *Sargassum* would most likely be present on some part of the proposed Site D USWTR during all parts of the year.

4.4.4 Commercial Shipping and Recreational Boating

Based on the ICOADS and AMVER data discussed in Subchapter 3.4.4, all of the proposed USWTR action alternative sites were in the “light” density regime (2-11 ships per day per 343 km² [100 NM²]). The ICOADS and AMVER data sets, and a third data set averaging the other two, all provided similar qualitative results. The Cherry Point site showed nearly double the intensity of any other site in both the ICOADS and ICOADS-AMVER average analyses. The discrepancy between Cherry Point and other sites was not as great in the AMVER analysis. VACAPES, Charleston, and Jacksonville (in respective order) ranked below Cherry Point in all three proxy analyses (Figure 3.4-9).

Most recreational boating occurs within a few miles of shore and is expected to be generally low in the vicinity of all four proposed USWTR sites (see Subchapter 3.4.3).

USWTR operational activities would be required to avoid shipping vessels transiting through the range area or recreational boaters within the range. Since the proposed range would be in international waters, no disruption to commercial shipping could be imposed. Commercial ship traffic or recreational boating activities within the operations area could require that the DoN delay, interrupt, or alter training exercises. Notice to Mariners or other public notice may be issued; if a notice is issued, it would be at least 72 hours in advance of a torpedo launching event.

4.4.5 Scuba Diving

Scuba diving in the vicinity of the proposed USWTR sites consists of diving on wrecks, artificial reefs and hard bottom structures. Many sites that are known as popular fishing areas (see Figures 3.4-2, 3.4-3, 3.4-4, and 3.4-8) also attract divers.

USWTR operational activities would be required to avoid scuba divers and their boats within the range. Scuba diving activities within the operations area could require that the DoN delay, interrupt, or alter training exercises. NOTAMs or other public notices may be issued; if a notice is issued, it would be at least 72 hours in advance of a torpedo launching event.


4.4.6 Marine Mammal Watching

Marine mammal watching (whale- and dolphin-watching), includes tours by boat, aircraft, or from land to view cetaceans. Marine mammal watching is also considered a category of marine tourism that can include activities, formal or informal, where people view, swim with, or listen to any cetacean species. The cetaceans targeted during tours include dolphins, whales, and porpoises.

Whale watching in the southeast occurs within a few miles of shore and rarely in federal waters. Based on the distribution and abundance of various marine mammal species and the location of popular ports for whale watching tours, the most commonly viewed cetaceans in the southeastern Atlantic coast include Atlantic bottlenose dolphins and humpback whales (Hoyt, 2001).

Whale watching tours are generally conducted from April through November. Tours typically last from one to two hours and commonly originate from Virginia Beach, Virginia; Nags Head, North Carolina; and Hilton Head Island, South Carolina. Most tours occur within a few miles of shore, with very few tours conducted in the vicinity of any of the four proposed USWTR sites.

Due to the fact USWTR training activities would occur in federal waters and that the Navy does not restrict commercial or recreational vessels from ocean areas for active sonar training, conflicts between use of the USWTR range and whale watching are unlikely.


4.5 Cultural Resources at Sea

4.5.1 Site A

As described in Subchapter 3.5, there are approximately 16 shipwrecks in the waters off of the northern coast of Florida (Figure 3.5-1). There are no shipwrecks within Site A covered by the NHPA. With respect to range instrumentation activities, known shipwreck locations would be avoided during installation. Thus, there would be no anticipated impacts to shipwrecks as a result of construction activities. The Navy is conducting bottom mapping of the proposed route of the trunk cable and the internode cables on the range. Through this investigation, the location of any shipwrecks will be determined prior to installation of the infrastructure of the range. Impacts to shipwrecks will be avoided in the installation of USWTR.

There are two known shipwrecks at the proposed Site A USWTR. Materials expended during the proposed operations would sink to the ocean bottom. The likelihood of these materials coming into contact with the shipwrecks within the proposed USWTR location would be minimal, due to the small proportion of area covered by them (Figure 3.5-1). If expended materials were to sink onto a shipwreck, they are unlikely to affect the historic properties of the shipwreck. In addition, the materials, like the shipwreck itself, would provide a substrate for benthic colonization and would likely be covered, over time, by shifting sediments. Thus, the proposed USWTR operations at Site A would not result in impacts to shipwrecks.

A hydrographic survey of the proposed path of the trunk cable was completed in 2008. That survey assessed cultural features that are likely to be in the path, and will allow for planning of a route that will minimize impact to cultural resources. By letter dated May 15, 2009 (see Appendix G for a copy of the letter), the Navy initiated consultation with the state of Florida’s Division of Historic Resources regarding potential impacts to historic resources through the construction of and training on USWTR Site A.

4.5.2 Site B

As described in Subchapter 3.5, there are numerous shipwrecks in the waters off South Carolina, with a large concentration located in Charleston and other harbors (Figure 3.5-2). With respect to range instrumentation activities, known shipwreck locations would be avoided during installation. Thus, there would be no anticipated impacts to shipwrecks as a result of construction activities. As there are no shipwrecks within Site B covered by the NHPA (Subchapter 3.5), there would be no adverse effect from installation of the USWTR.

There is one known shipwreck at the proposed Site B USWTR. Materials expended during the proposed operations would sink to the ocean bottom. The likelihood of these materials coming into contact with the shipwreck within the proposed USWTR location would be minimal, due to the small proportion of area covered by it (Figure 3.5-2). If expended materials were to sink onto a shipwreck, they are unlikely to affect the historic properties of the shipwreck. In addition, the
materials, like the shipwreck itself, would provide a substrate for benthic colonization and would likely be covered, over time, by shifting sediments. Thus, the proposed USWTR operations at Site B would not result in impacts to shipwrecks.

### 4.5.3 Site C

As described in Subchapter 3.5, shipwrecks and/or obstructions are known to occur within the Cherry Point OPAREA (Figure 3.5-3). Bathymetric surveys conducted in support of determining the best location to place transducer nodes did not reveal any shipwrecks within the area of potential effects. In the event that a shipwreck is encountered during final planning and/or installation, plans would be altered to avoid any shipwrecks and/or obstructions. Thus, there would be no anticipated impacts to shipwrecks as a result of construction activities. As there are no shipwrecks within Site C covered by the NHPA, there would be no adverse effect from installation of the USWTR.

Materials expended during the proposed operations would sink to the ocean bottom. The likelihood of these materials coming into contact with a shipwreck within the proposed USWTR location would be minimal, due to the small proportion of area covered by the four shipwrecks at Site C (Figure 3.5-3). If expended materials were to sink onto a shipwreck, it is unlikely that they would affect the historic properties of the shipwreck. Thus, there would be no impacts to cultural resources as a result of operations at the proposed Onslow USWTR.

### 4.5.4 Site D

As described in Subchapter 3.5, the VACAPES OPAREA contains approximately 160 shipwrecks (Figure 3.5-4). With respect to range instrumentation activities, known shipwreck locations would be avoided during installation. Thus, there would be no anticipated impacts to shipwrecks as a result of construction activities. As there are no shipwrecks within Site D covered by the NHPA, there would be no adverse effect from installation of the USWTR.

There are four known shipwrecks at the proposed Site D USWTR. Materials expended during the proposed operations would sink to the ocean bottom. As discussed for the other sites, if a shipwreck were present, it is unlikely that materials expended during the proposed USWTR exercises would come into contact with it, due to the small proportion of area covered by the five shipwrecks at Site C (Figure 3.5-4). If expended materials were to sink onto a shipwreck, it is unlikely that they would affect the historic properties of the shipwreck. Thus, the proposed USWTR operations at Site D would not result in impacts to shipwrecks.
4.6 Landside Impacts

4.6.1 Site A

4.6.1.1 Land Use

The Cable Termination Facility (CTF) would be located on a currently undeveloped site that is adjacent to an existing roadway and parking lot that serve administrative and training buildings. CTF construction operations would be comparable to those of a similarly sized building, such as a garage, and would occur over a period of between three and six months. While the construction and operation of the proposed CTF would represent a change in land use from existing undeveloped land, the proposed use would be consistent with the surrounding military uses. The trunk cable running to the CTF would be buried and would not affect land use. The directional drilling operations would require an area of approximately 465 m² (5,000 ft²) and would occur over a period of between three and six months. As feasible, the drilling operations would be sited on developed land (e.g., a parking lot), or on previously disturbed, vacant land and restored after construction. Thus, there would be no land use impacts at the proposed Site A landfall site.

4.6.1.2 Socioeconomics

Demographics

The residents of Duval County would not be affected by the construction and operation of the proposed USWTR. The construction and operation would not result in any new permanent or short-term (e.g., construction) jobs in the area. The location and operation of the CTF, a small structure located above ground on federal property – the use of which would be restricted to military or other authorized personnel – would cause no impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

Environmental Justice

The Navy has evaluated the proposed action at the Naval Station (NS) Mayport landfall site in accordance with the requirements of EO 12898 and has determined that the proposed action would not result in disproportionately high and adverse environmental or health impacts on minority or low-income populations. There would be no direct or indirect environmental or economic impacts specific to any groups from minority or low-income populations in the vicinity of the landside facilities. The location and operation of the CTF, a small structure located above ground on federal property – the use of which would be restricted to military or other authorized personnel – would cause no such adverse impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.
The Navy has also evaluated the construction and operation of USWTR facilities in accordance with the requirements of EO 13045, which addresses risks attributable to products or substances that a child is likely to come in contact with or ingest. The construction and operation of the CTF would not result in the introduction of substances that would create health risks and safety risks for children. No hazardous materials or waste would be stored on site. In addition, short-term constructions activities will not affect children, as there are no schools, daycare facilities, or residences nearby, and there is controlled access to the site at all times. Thus, implementation of the proposed action would not pose disproportionate environmental health risks and safety risks to children.

4.6.1.3 Natural Resources

Navigable Waters

The proposed installation of the undersea cable and sensor nodes would have no significant impact on navigable waters. However, the proposed action would require approval from the USACE pursuant to Section 10 of the Rivers and Harbors Act (Section 10) as well as Section 404 of the Clean Water Act (Section 404). The directional drilling installation of the trunk cable under Section 404 waters does not require a Section 404 permit for the proposed action.

With respect specifically to the proposed Site A landfall site, the permit application would be submitted to the Jacksonville District of the USACE. In addition to the Section 10 and 404 permits, Section 401 authorization would need to be obtained from the Florida Department of Environmental Protection.

Wetlands

There are no NWI-identified wetlands at the proposed Site A landfall site (Figure 3.6-1). With implementation of the proposed action, a trunk cable would be buried within the coastal zone and would terminate in the CTF (Chapter 2). While installing the landside portion of the trunk cable, directional drilling would be used to avoid wetlands to the maximum extent practicable. Directional drilling, versus open trench techniques, would enable installation of the cable under wetlands with minimal disturbance to the overlying ecological community. No impacts to estuarine and/or freshwater wetlands would be anticipated with implementation of the proposed action at the Site A landfall location.

Threatened and Endangered Species

Wood Stork

The construction and operation of the proposed USWTR at the Site A landfall site would have no effect on the activities of the wood stork observed near NS Mayport, as there are no documented nests in the immediate vicinity of the CTF; and no esturine wetlands, required by the wood stork for nesting and foraging, exist in the landfall vicinity.
Piping Plover

Although piping plover have not been observed using the beach at NS Mayport, they have been documented in Duval County. High levels of human activity on the beach discourage piping plover from nesting, and foraging activities have not been documented. The proposed action would have no effect on piping plover since they have not been documented on the station’s beach.

Sea Turtles

There could be temporary impacts to the nesting activities of the loggerhead, leatherback, and green sea turtles if installation occurs during nesting months; however, under such circumstances, consultation with the USFWS would be arranged before initiating any construction activities. Current conservation measures in place at NS Mayport beach would minimize or eliminate the potential for adverse impact. These conservation measures include marking known sea turtle nesting areas with protective fencing and avoiding disturbance of those areas.

Manatees

Shallow grass beds are preferred feeding areas for manatees in coastal habitats. Extensive seagrass beds, if present, are not likely to occur in the turbid waters off the beach at NS Mayport and thus, manatee presence is expected to be limited. Impact to these seagrass beds would be minimal due to planned use of horizontal directional drilling to install the nearshore trunk cable. Mitigation measures outlined in Chapter 6 would ensure that marine mammals, including manatees that may occur in the nearshore waters, do not become entangled during the cable installation process. Also with respect to manatees, the construction period for installing cable is of limited duration; thus, there would be a limited period during which vessels and construction equipment could come into contact with marine mammals. The Navy concludes that the potential for adverse effects is extremely low. Therefore, the installation of cable would not affect manatees.

Essential Fish Habitat

As described in Subchapter 4.2.3, no significant impact to non-hard bottom nearshore EFH is anticipated from the installation process at Site A. Hard bottom nearshore EFH could experience a reduction of the quantity and/or quality and therefore may be adversely affected.

Migratory Birds

Although migratory birds utilize the nearby NS Mayport beach as part of their migratory activities, the construction and operation of the USWTR at the landside site would have no significant impact on those activities. The construction would be temporary and there are ample foraging/sheltering grounds for migratory birds in the region. Additionally, the beach at NS
Mayport is used heavily by recreational beach-goers. Frequent human activity discourages migratory waterbirds from foraging in these areas. Therefore, no significant impacts to migratory waterbirds are expected.

Vegetation and Soils

Minimal clearing of existing maritime scrub/shrub vegetation would be required. The trunk cable would be installed underground. The proposed action is not expected to affect the current rate of coastal erosion at NS Mayport.

Floodplain Management

Installation of the USWTR landside facilities at NS Mayport would require construction in the 100-year floodplain. The Navy has determined that there is no other practicable alternative that would avoid construction in the floodplain (the USWTR trunk cable must come ashore and connect to a CTF near the shoreline). The Navy would prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

Construction of the proposed landside facilities would not result in impacts to beneficial uses of the floodplain because:

- Trenching of the trunk cable and construction of the CTF would not change the topography and configuration of the floodplain.
- The cumulative effects of the proposed landside facilities would not increase the water surface elevation of the base flood.

The lowest floor of the CTF at NS Mayport would be elevated to or above the 100-year flood elevation or would be flood-proofed to be watertight to the 100-year flood elevation.

4.6.1.4 Cultural Resources

There would be no effect on cultural resources at the NS Mayport, as there are no known cultural resources in the immediate vicinity of the site.

4.6.1.5 Air Quality

There would be no new sources of air pollutants at the landside facility. Furthermore, the CAA conformity rules would not apply to the landside facilities or in nearshore areas within the 6-km (3-NM) jurisdiction of the CAA, as they would be within an attainment area for all criteria pollutants. Any new stationary sources would be added to the current permit for NS Mayport. Air quality impacts from construction activities at NS Mayport would be from fugitive dust generated on site and mobile source emissions from construction vehicles and workers’ automobiles. These impacts would be minor and would be short-term in nature. Thus, the construction and operation
of the proposed USWTR would have no significant impact on air quality in the vicinity of NS Mayport.

4.6.1.6 Hazardous Materials

Construction and operation of the NS Mayport USWTR landside facilities would not result in significant quantities of hazardous materials being used or generated. Small quantities of standard maintenance and repair materials (e.g., solder flux, flux remover, isopropyl alcohol, and petroleum products) may be used as needed and would be disposed of in accordance with all applicable regulations.

4.6.2 Site B

4.6.2.1 Land Use

The CTF would be located on Fort Moultrie National Monument on Sullivan’s Island. There would be no land use impacts at the beachfront landfall site. Operation of the CTF would be consistent with the ongoing historic and recreational land use of Fort Moultrie and would not impact existing natural resources. The directional drilling operations would require an area of approximately 465 m² (5,000 ft²) and would occur over a period of between three and six months. As feasible, the drilling operations would be sited on developed land (e.g., a parking lot), or on previously disturbed, vacant land and restored after construction.

4.6.2.2 Socioeconomics

Demographics

The residents of Charleston County would not be affected by the construction and operation of the proposed USWTR. The construction and operation would not result in any new permanent or short-term (e.g., construction) jobs in the area. The location and operation of the CTF, a small structure located above ground on federal property – the use of which would be restricted to military or other authorized personnel – would cause no impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

Environmental Justice

The Navy has evaluated the proposed action at the Fort Moultrie landfall site in accordance with the requirements of EO 12898 and has determined that the proposed action would not result in disproportionately high and adverse environmental or health impacts on minority or low-income populations. There would be no direct or indirect environmental or economic impacts specific to any groups from minority or low-income populations in the vicinity of the landside facilities. The location and operation of the CTF, a small structure located above ground on federal property –
the use of which would be restricted to military or other authorized personnel – would cause no such adverse impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

The Navy has also evaluated the construction and operation of USWTR facilities in accordance with the requirements of EO 13045, which addresses risks attributable to products or substances that a child is likely to come in contact with or ingest. The construction and operation of the CTF would not result in the introduction of substances that would create health risks and safety risks for children. No hazardous materials or waste would be stored on site. In addition, short-term constructions activities will not affect children, as there are no schools, daycare facilities, or residences nearby, and there is controlled access to the site at all times. Thus, implementation of the proposed action would not pose disproportionate environmental health risks and safety risks to children.

4.6.2.3 Natural Resources

Navigable Waters

The proposed installation of the undersea cable and sendor nodes would have no significant impact on navigable waters. However, the proposed action would require approval from the USACE pursuant to Section 10 as well as Section 404. The directional drilling installation of the trunk cable under Section 404 waters does not require a Section 404 permit for the proposed action.

With respect specifically to the proposed Site B landfall site, the permit application would be submitted to the Charleston District of the USACE. In addition to the Section 10 and 404 permits, Section 401 authorization would need to be obtained from the South Carolina Department of Health and Environmental Control (SCDHEC).

Wetlands

There are no NWI-identified wetlands at the proposed Site B landfall site (Figure 3.6-2). With implementation of the proposed action, a trunk cable would be buried within the coastal zone and would terminate in the CTF (Chapter 2). While installing the landside portion of the trunk cable, directional drilling would be used to avoid wetlands to the maximum extent practicable. Directional drilling, versus open trench techniques, would enable installation of the cable under wetlands with minimal disturbance to the overlying ecological community. No impacts to estuarine and/or freshwater wetlands would be anticipated with implementation of the proposed action at the Site B landfall location.
Threatened and Endangered Species

Plants

A plant survey has not been performed in the vicinity of the Fort Moultrie National Monument, and therefore it is unknown whether the seabeach amaranth, Canby’s dropwort, and American chaffseed are present in this area. If Site B is selected as the preferred alternative a plant survey will be performed prior to installation and the Navy will consult with the USFWS if any of these species are found.

Wood Stork

The construction and operation of the proposed USWTR at the Site B landfall site would have no effect on the activities of the wood stork observed near Fort Moultrie National Monument, as there are no documented nests in the immediate vicinity of the CTF; and estuarine wetlands, required by the wood stork for nesting and foraging, do not exist in the landfall site.

Piping Plover

Although piping plover have not been observed using the beach at Fort Moultrie, they have been documented in Charleston County. High levels of human activity on the beach discourage piping plover from nesting, and foraging activities have not been documented. Therefore, proposed action would have no effect on piping plover.

Sea Turtles

There could be temporary impacts to the nesting activities of the loggerhead turtle if installation occurs during nesting months; however, under such circumstances, consultation with the USFWS would be arranged before initiating any construction activities. Current conservation measures in place on Sullivan’s Island include marking known sea turtle nesting areas with protective fencing and avoiding disturbance of those areas. The construction and operation of the proposed USWTR at the Site B landfall site may affect, but is not likely to adversely affect, sea turtles.

Manatees

Shallow grass beds are preferred feeding areas for manatees in coastal habitats. Extensive grass beds are not likely to occur off the beach at Sullivan’s Island and thus, manatee presence is expected to be limited, as the prefer the harbor, Intracoastal waterway, and creeks in the Charleston vicinity. Mitigation measures outlined in Chapter 6 would ensure that marine mammals, including manatees that may occur in the nearshore waters, do not become entangled during the cable installation process. Also with respect to manatees, the construction period for installing cable is of limited duration; thus, there would be a limited period during which vessels and construction equipment could come into contact with marine mammals. The Navy concludes
that the potential for adverse effects to manatees is extremely low. Therefore, the placement and burial of cable would not affect manatees.

**Essential Fish Habitat**

The potential effects to EFH occurring in the nearshore Atlantic waters would be the same as described in Subchapter 4.2.3.

**Migratory Birds**

Although migratory birds may utilize beach near Fort Moultrie National Monument as part of their migratory activities, the construction and operation of the USWTR at the landside site would have no significant impact on those activities. The construction would be temporary and there are ample foraging/sheltering grounds for migratory birds in the region. Additionally, the Fort Moultrie National Monument has many visitors and human activity discourages migratory waterbirds from foraging in these areas. Therefore, no significant impacts to migratory waterbirds are expected.

**Vegetation and Soils**

Minimal clearing of existing maritime scrub/shrub vegetation would be required. The trunk cable would be installed underground. The proposed action is not expected to affect the current rate of coastal erosion at Fort Moultrie National Monument.

**Floodplain Management**

Installation of the USWTR landside facilities at Fort Moultrie National Monument would require construction in the 100-year floodplain. The Navy has determined that there is no other practicable alternative that would avoid construction in the floodplain (the USWTR trunk cable must come ashore and connect to a CTF near the shoreline). The Navy would prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

Construction of the proposed landside facilities would not result in impacts to beneficial uses of the floodplain because:

- Trenching of the trunk cable and construction of the CTF would not change the topography and configuration of the floodplain.

- The cumulative effects of the proposed landside facilities would not increase the water surface elevation of the base flood.
The lowest floor of the CTF at Fort Moultrie would be elevated to or above the 100-year flood elevation or would be flood-proofed to be watertight to the 100-year flood elevation.

4.6.2.4 Cultural Resources

There would be no adverse effect on cultural resources at the Fort Moultrie National Monument, as the trunk cable would be installed under the dunes to the east of the proposed CTF, using directional drilling techniques, and the CTF would be located inside an existing building.

4.6.2.5 Air Quality

There would be no new sources of air pollutants at the landside facility. Furthermore, the CAA conformity rules would not apply to the landside facilities or in nearshore areas within the 6-km (3-NM) jurisdiction of the CAA, as they would be within an attainment area for all criteria pollutants. Air quality impacts from construction activities at Fort Moultrie National Monument would be from fugitive dust generated on site and mobile source emissions from construction vehicles and workers’ automobiles. These impacts would be minor and would be short-term in nature. Thus, the construction and operation of the proposed USWTR would have no significant impact on air quality in the vicinity of Fort Moultrie National Monument.

4.6.2.6 Hazardous Materials

Construction and operation of the Fort Moultrie National Monument USWTR landside facilities would not result in significant quantities of hazardous materials being used or generated. Small quantities of standard maintenance and repair materials (e.g., solder flux, flux remover, isopropyl alcohol, and petroleum products) may be used as needed and would be disposed of in accordance with all applicable regulations.

4.6.3 Site C

4.6.3.1 Land Use

There would be no land use impacts at the beachfront landfall site. The installation of the trunk cable by directional drilling operations would require an area of approximately 465 m² (5,000 ft²) and would occur over a period of between three and six months. If feasible, the drilling operations would be sited on developed land (e.g., a parking lot), or on previously disturbed, vacant land and restored after construction. CTF construction operations would be comparable to those of a similarly sized building, such as a garage, and would occur over a period of between three and six months. Operation of the CTF would be consistent with the ongoing military and recreational land use of Onslow Beach and would not impact existing natural resources.
4.6.3.2 Socioeconomics

Demographics

The residents of Onslow County would not be affected by the construction and operation of the proposed USWTR. The construction and operation would not result in any new permanent or short-term (e.g., construction) jobs in the area. The location and operation of the CTF, a small structure located above ground on federal property – the use of which would be restricted to military or other authorized personnel – would cause no impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

Environmental Justice

The Navy has evaluated the proposed action at the Onslow Beach landside site in accordance with the requirements of EO 12898 and has determined that the proposed action would not result in disproportionately high and adverse environmental or health impacts on minority or low-income populations. There would be no direct or indirect environmental or economic impacts specific to any groups from minority or low-income populations in the vicinity of the Onslow Beach landside facilities. The location and operation of the CTF, a small structure located above ground on federal property – the use of which would be restricted to military or other authorized personnel – would cause no such adverse impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

The Navy has also evaluated the construction and operation of USWTR facilities in accordance with the requirements of EO 13045, which addresses risks attributable to products or substances that a child is likely to come in contact with or ingest. The construction and operation of the CTF would not result in the introduction of substances that would create health risks and safety risks for children. No hazardous materials or waste would be stored on site. In addition, short-term constructions activities will not affect children, as there are no schools, daycare facilities, or residences nearby, and there is controlled access to the site at all times. Thus, implementation of the proposed action would not pose environmental health risks and safety risks to children.

4.6.3.3 Natural Resources

Navigable Waters

The proposed installation of the undersea cable and sensor nodes, as well as the conduit under the Intracoastal Waterway would have no significant impact on navigable waters. However, the proposed actions would require approval from the USACE pursuant to Section 10 and Section 404. The directional drilling installation of the trunk cable under Section 404 waters does not require a Section 404 permit for the proposed action.
With respect specifically to proposed Onslow Beach landfall site, the permit application would be submitted to the Wilmington District of the USACE. In addition to the Section 10 and 404 permit, Section 401 authorization would need to be obtained from the North Carolina Division of Water Quality.

Wetlands

Estuarine wetland areas occur in the vicinity of the proposed Onslow Beach landfall site (Subchapter 3.6 and Figure 3.6-1). With implementation of the proposed action, a trunk cable would be buried within the coastal zone and would terminate at the CTF (Chapter 2). The CTF would be sited to, or installation methods would avoid, the wetland areas. While installing the landside portion of the trunk cable, directional drilling would be used to avoid estuarine wetlands. Directional drilling, versus open trench techniques, would enable installation of the cable under wetlands with minimal disturbance to the overlying ecological community. No impacts to estuarine wetlands would be anticipated with implementation of the proposed action at the Onslow Beach landfall site.

Threatened and Endangered Species

Seabeach Amaranth

No sand-pushing or bulldozing is expected in the dune area; however, the directional drilling equipment may bury seeds or interfere with seed dispersal. Additionally, plants could be run over or trampled by vehicular/pedestrian traffic.

Currently implemented conservation measures, developed through ESA Section 7 consultations between MCB Camp Lejeune and the USFWS (USFWS, 2002) include annual vegetation surveys conducted from mid-June through the end of the growing season. Identified seabeach amaranth is marked with “endangered species site” to exclude vehicular traffic and minimize human disturbance. If plants or propagules are observed, construction activities would be delayed into natural plant senescence. Implementation of the proposed action at the Onslow Beach landfall site may affect but is unlikely to adversely affect the seabeach amaranth. The Navy will consult with the USFWS if this alternative is chosen.

Sea Turtles

Construction activities related to installation of the trunk cable at the beach location could have temporary impacts to the nesting activities of the loggerhead and green sea turtles. Current conservation measures in place at MCB Camp Lejeune would minimize or eliminate the potential for adverse impact. These conservation measures include a sea turtle nest relocation program. Trained personnel excavate and relocate to safe areas all nests laid in the designated military training area, below the mean high tide, or where known hazards exist and cannot be mitigated. In addition to the current conservation measures, the trunk cable would be buried 1 m (3 ft) deep on the beachfront and then beneath the dune structure by directional drilling. This
would eliminate any potential for nesting females to become entangled since nest cavities generally extend to a depth of less than 0.6 m (2 ft). Construction activities on the beach would take place during daytime hours for only a few days, lessening the chance for interaction with nesting sea turtles. Finally, Camp Lejeune biologists would monitor the construction activities to ensure that all appropriate protective measures are taken. These measures include removing or securing obstacles in the vicinity of the construction site. The CTF would be located landward of the dune structure. Implementation of the proposed action at the Onslow Beach landfall site may affect but is not likely to adversely affect loggerhead and green sea turtles. The Navy will initiate consultation with the USFWS if this alternative is selected.

**Piping Plover**

The construction and operation of the USWTR at the landside site would have no significant impact on the foraging activities of piping plovers that have been observed at Onslow Beach. The construction activities would be temporary and there are ample foraging grounds for the piping plovers in the region. As discussed in Subchapter 3.6, though no nesting piping plovers have been documented on Onslow Beach, their preferred nesting habitat is available and nesting plovers have been documented both to the north and south of Onslow Beach. Thus, temporary impacts to the nesting activities of piping plovers could occur if the cable were installed at the beachfront site during the period from mid-March to mid-May.

Currently implemented conservation measures, developed through ESA Section 7 consultations between MCB Camp Lejeune and the USFWS (USFWS, 2002), include bi-monthly surveys for piping plovers to document plover use of Onslow Beach. If nesting behavior or nests are identified, the area or nest is posted with signs prohibiting vehicular or human access. Prior to any dune construction activities, project areas and the surrounding area are surveyed for adult, young, or nests of piping plover. If a nest is located or adults are exhibiting breeding behavior within 90 m (300 ft) of a proposed project site, the project is delayed until the breeding season is complete. Adherence to the conservation measures currently in place would eliminate the potential for adverse effects on piping plovers.

**Essential Fish Habitat**

As described in Subchapter 4.2.3, no significant impact to non-hard bottom nearshore EFH is anticipated from the installation process at Site C. Hard bottom nearshore EFH could experience a reduction of the quantity and/or quality and therefore may be adversely affected.
Migratory Birds

Although migratory birds utilize Onslow Beach (e.g., as foraging habitat), the construction and operation of the USWTR at the landside site would have no significant impact on foraging activities. The construction activities would be temporary and there are ample foraging grounds for migratory birds in the region. Further, because the location of the proposed cable is a busy recreational area, the existing level of disturbance is not conducive to foraging waterbirds.

Vegetation and Soils

Minimal clearing of existing maritime scrub/shrub vegetation would be required. The trunk cable would be installed in by directional drilling from a point near the CTF under the beach and the Intracoastal Waterway to a location about 1,000 m (3,000 ft) off shore. The CTF would be built in the vicinity of Mockup Road and would have minimal impact on vegetation and soils and would not be placed near sensitive plant or animal areas described in previous sections. Cable installation is not anticipated to accelerate coastal erosion or barrier island migration.

Floodplain Management

Installation of the proposed Site C USWTR landside facilities would require construction within the 100-year floodplain (the trenching of cable on shore and the construction of the CTF). The Navy has determined that there is no other practicable alternative that would avoid construction in the floodplain (the USWTR trunk cable must come ashore and connect to a CTF near the shoreline). The Navy would prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

Construction of the proposed landside facilities would not result in impacts to beneficial uses of the floodplain because:

- Trenching of a fiber-optic cable and construction of the CTF would not change the topography and configuration of the floodplain.
- The cumulative effect of the proposed landside facilities, when combined with all other existing and anticipated development on Onslow Beach, would not increase the water surface elevation of the base flood.

The lowest floor of the CTF at Onslow Bay would be elevated to or above the 100-year flood elevation or would be flood-proofed to be watertight to the 100-year flood elevation.

4.6.3.4 Cultural Resources

As described in Subchapter 3.6, there is only one site at Onslow Beach that is eligible for inclusion in the National Register of Historic Places. However, this site is near the southwest
end of the beach and is not within the vicinity of the proposed trunk cable installation and CTF site. Thus, it would not be impacted by proposed construction activities.

4.6.3.5 Air Quality

There would be no new permanent sources of air emissions at the landside facility. Furthermore, the CAA conformity rules would not apply to the landside facilities or in nearshore areas within the 6-km (3-NM) jurisdiction of the CAA, as they would be within an attainment area for all criteria pollutants. Air quality impacts from construction activities would be from fugitive dust generated on site and mobile-source emissions from construction vehicles and workers’ automobiles. These impacts would be minor and would be short-term in nature. Thus, the construction and operation of the proposed USWTR would have no significant impact on air quality in the vicinity of Onslow Beach.

4.6.3.6 Hazardous Materials

Onshore construction and operation of the Site C USWTR landside facilities would not result in significant quantities of hazardous materials being used or generated. Small quantities of standard maintenance and repair materials (e.g., solder flux, flux remover, isopropyl alcohol, and petroleum products) may be used as needed and would be disposed of in accordance with all applicable regulations.

4.6.4 Site D

4.6.4.1 Land Use

The directional drilling operations would require an area of approximately 465 m² (5,000 ft²) and would occur over a period of between three and six months. If feasible, the drilling operations would be sited on developed land (e.g., a parking lot), or on previously disturbed, vacant land and restored after construction. CTF construction operations would be comparable to those of a similarly sized building, such as a garage, and would occur over a period of between three and six months. The proposed action would have no significant impact on the existing land use of Wallops Island, as it is consistent with present military and NASA uses on the island.
4.6.4.2 Socioeconomics

Demographics

The residents of Accomack County would not be affected by the construction and operation of the proposed USWTR. The location and operation of the CTF, a small structure located above ground on federal property – the use of which would be restricted to military or other authorized personnel – would cause no impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

Environmental Justice

The Navy has evaluated the proposed action at the Site D landside site in accordance with the requirements of EO 12898 and has determined that the proposed action would not result in disproportionately high and adverse environmental or health impacts on minority or low-income populations. There would be no direct or indirect environmental or economic impacts specific to any groups from minority or low-income populations in the vicinity of the Site D landside facilities. The location and operation of the CTF – the use of which would be restricted to military or other authorized personnel – would cause no such adverse impacts. In addition, there would be no displacement of persons associated with implementation of the landside components of the proposed action.

The Navy has also evaluated the construction and operation of USWTR facilities in accordance with the requirements of EO 13045, which addresses risks attributable to products or substances that a child is likely to come in contact with or ingest. The construction and operation of the CTF would not result in the introduction of substances that would create health risks and safety risks for children. No hazardous materials or waste would be stored on site. In addition, short-term constructions activities will not affect children, as there are no schools, daycare facilities, or residences nearby, and there is controlled access to the site at all times. Thus, implementation of the proposed action would not pose disproportionate environmental health risks and safety risks to children.

4.6.4.3 Natural Resources

Navigable Waters

The proposed installation of the undersea cable and sensor nodes would have no significant impact on navigable waters. However, the proposed action would require approval from the USACE pursuant to Section 10 as well as Section 404. The directional drilling installation of the trunk cable under Section 404 waters does not require a Section 404 permit for the proposed action.

With respect specifically to the proposed Site D landfall site, the permit application would be submitted to the Norfolk District of the USACE. In addition to the Section 10 and 404 permit,
Section 401 authorization would need to be obtained from the Virginia Department of Environmental Quality.

Wetlands

Estuarine and freshwater wetland areas occur in the vicinity of the proposed Site D landfall location (Subchapter 3.6 and Figure 3.6-3). With implementation of the proposed action, a trunk cable would be buried within the coastal zone and would terminate in the CTF (Chapter 2). The CTF would be sited to avoid the wetland areas. While installing the landside portion of the trunk cable, directional drilling would be used to avoid wetlands to the maximum extent practicable. Directional drilling would enable installation of the trunk cable under wetlands with minimal disturbance to the overlying ecological community. If wetlands cannot be avoided during siting or drilling, mitigation would be provided for any wetlands impacted. Therefore, no impacts to estuarine and/or freshwater wetlands would be anticipated with implementation of the proposed action at the Site D landfall site.

Threatened and Endangered Species

The riprap seawall prevents sea turtles from nesting on the portion of the island where the trunk cable and CTF would be installed; thus, there would be no effect on sea turtle nesting.

The site is more than 3.2 km (2 mi) away from the Atlantic Coast piping plover breeding area on the northern end of the island, and more than 4 km (2.5 mi) from the breeding area at the southern end of the island. Therefore, no effects to the plover colonies are anticipated and no consultation with the USFWS would occur. The construction and operation of the USWTR at the landside site would have no significant impact on the foraging activities of piping plovers. The construction activities would be temporary and there are ample foraging grounds for the piping plovers in the region.

Essential Fish Habitat

As described in Subchapter 4.2.3, no significant impact to non-hard bottom nearshore EFH is anticipated from the installation process at Site D. Hard bottom nearshore EFH could experience a reduction of the quantity and/or quality and therefore may be adversely affected.

Migratory Birds

Although migratory birds utilize Wallops Island (e.g., as foraging habitat), the construction and operation of the USWTR at the landside site would have no significant impact on foraging activities. The construction activities would be temporary and there are ample foraging grounds for migratory birds in the region. Additionally, the riprap seawall makes the area around the proposed cable installation less favored for waterbird foraging.
Vegetation and Soils

Cable installation activities, such as trenching or directional boring, would have no long-term significant impacts on the natural resources of Wallops Island. Short-term impacts would include the disturbance of soil and vegetation during the construction phase. However, all areas would be returned to predisturbance grade following the completion of the cable installation. The installation of the cable is not expected to affect shoreline erosion rates or barrier island dynamics as the system is somewhat stabilized by oceanfront seawall.

Floodplain Management

Installation of the Site D USWTR landside facilities would require construction in the 100-year floodplain. The Navy has determined that there is no other practicable alternative that would avoid construction in the floodplain (the USWTR trunk cable must come ashore and connect to a CTF near the shoreline). The Navy would prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

Construction of the proposed landside facilities would not result in impacts to beneficial uses of the floodplain because:

- Trenching of a fiber-optic cable and construction of the CTF would not change the topography and configuration of the floodplain.
- The cumulative effect of the proposed landside facilities, when combined with all other existing and anticipated development on Wallops Island, would not increase the water surface elevation of the base flood.

The lowest floor of the CTF at Wallops Island would be elevated to or above the 100-year flood elevation or would be flood-proofed to be watertight to the 100-year flood elevation.

4.6.4.4 Cultural Resources

There would be no adverse impacts on cultural resources at Wallops Island. The VRCA performed a preliminary archaeological study of the property where the ACSC now exists, with negative findings. The VRCA considers Wallops Island to be low in potential for historical archaeological resources. Although VRCA considers the island to have good potential for prehistoric artifacts, no archaeological sites have ever been reported on the island.

4.6.4.5 Air Quality

There would be no new sources of air pollutants at the landside facility. Furthermore, the CAA conformity rules would not apply to the landside facilities or in nearshore areas within the 6-km (3-NM) jurisdiction of the CAA, as they would be within an attainment area for all criteria pollutants. As discussed for Site C, air quality impacts from construction activities at Wallops
Island would be from fugitive dust generated on site and mobile-source emissions from construction vehicles and workers’ automobiles. These impacts would be minor and would be short-term in nature. Thus, the construction and operation of the proposed USWTR would have no significant impact on air quality in the vicinity of Wallops Island.

4.6.4.6 Hazardous Materials and Wastes

Onshore construction and operation of the Site D USWTR landside facilities would not result in significant quantities of hazardous materials being used or hazardous wastes being generated. Small quantities of standard maintenance and repair materials (e.g., solder flux, flux remover, isopropyl alcohol, and petroleum products) may be used as needed and would be disposed of in accordance with all applicable regulations. In addition to the applicable regulations specifying minimum requirements for management of hazardous materials and hazardous wastes, the NASA WFF Integrated Contingency Plan provides additional, site-specific requirements.
4.7 Coastal Zone Management

Federal agency activities affecting a state’s coastal zone must be consistent to the maximum extent practicable with the enforceable policies of the state’s coastal management program. The Coastal Zone Management Act (CZMA) of 1972 (16 USC 1451, et seq.) was enacted to protect coastal resources from growing demands associated with commercial, residential, recreational and industrial uses. The CZMA allows coastal states to develop a Coastal Zone Management Plan (CZMP) whereby they designate permissible land and water use within the state’s coastal zone. States then have the opportunity to review and comment on federal agency activities that could affect the state’s coastal zone or its resources.

Federal agency activities potentially affecting a state’s coastal zone must be consistent, to the maximum extent practicable, with the enforceable policies of the state’s coastal management program. Enforceable policies of a state’s coastal management plan generally consist of existing state statutes and codes that have been combined to comprise the CZMP. Typically, a state’s CZMP will focus on the protection of physical, biological, and socioeconomic resources.

Review of federal agency activities is conducted through the submittal of either a Consistency Determination or a Negative Determination. A federal agency shall submit a Consistency Determination when it determines that its activity may have either a direct or an indirect effect on a state’s coastal zone or resources. In accordance with 15 CFR 930.39, the consistency determination shall 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 and should be based upon an evaluation of the relevant enforceable policies of the management program.

Pursuant to 15 CFR 930.41, the state has 60 days from the receipt of the Consistency Determination in which to concur with or object to the Consistency Determination, or to request an extension under 15 CFR 930.41(b). Federal agencies shall approve one request for an extension period of 15 days or less.

A federal agency may submit a Negative Determination to a coastal state when the federal agency has determined that its activities would not have an effect on the state’s coastal zone or its resources or when conducting the same or similar activities for which Consistency Determinations have been prepared in the past. Pursuant to 15 CFR 930.35 the state has 60 days to review a federal agency’s Negative Determination. States are not required to concur with a Negative Determination, and if the federal agency has not received a response from the state by the 60th day of submittal, it may proceed with its action. However, within the 60-day review period, a state agency may request, and the federal agency shall approve, one request for an extension period of 15 days or less.

Table 4.7-1 summarizes relevant enforceable policies by state, anticipated impacts of the proposed project, and a policy consistency determination for each of the policies identified for each of the four sites.
In accordance with the CZMA, the Navy has reviewed the enforceable policies of each state’s CZMP where the four alternative sites are located. Pursuant to 15 CFR 930.39, the Navy has prepared a Consistency Determination for the state of Florida, and a Negative Determination for the state of Georgia. Appendix F contains the Navy’s Consistency Determination and the Negative Determination associated with the Proposed Action. Appendix G contains copies of the letters from the Navy dated April 29, 2009 that submitted the Consistency Determination to the state of Florida and the Negative Determination to the state of Georgia.
### Table 4.7-1

State Coastal Zone Enforceable Policies

<table>
<thead>
<tr>
<th>State</th>
<th>Relevant Enforceable Policy</th>
<th>Analysis</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Florida             | Beach and shore preservation  
Growth policy, county and municipal planning, land development regulation  
State and regional planning  
Emergency management  
State lands  
State parks and preserves  
Land acquisition for conservation or recreation  
Florida greenways and trails act  
Historical resources  
Commercial development and capital improvements  
Transportation administration  
Transportation finance and planning  
Saltwater fisheries  
Wildlife  
Water resources | Cable burial is the only activity proposed for the area seaward of the mean high water line and within state coastal waters.  
Naval Station Mayport is federal property.  
Naval Station Mayport is federal property.  
The proposed action would not increase the State’s vulnerability to natural disasters. Emergency response and evacuation procedures are not applicable to the proposed action.  
Naval Station Mayport is federal property.  
The proposed action would not affect any state parks or preserves.  
No effect on land acquisition for conservation or recreation.  
The proposed action would avoid the recreational trails system and would not affect the management of the system.  
No effect on historical resources.  
The proposed action would not involve any commercial development or capital improvements that would affect the business, trade, or tourist components of the state economy.  
The proposed action would not affect transportation.  
The proposed action would not affect transportation.  
No lethal or long-term impact to fish and no significant impact to fish habitats.  
No significant effect on wildlife.  
Installation of the trunk cable at the proposed landfall site would cause minimal, short-term impacts to water quality because bottom sediments would be disturbed. Disturbed bottom sediments can cause increased turbidity that can clog fish gills and can decrease oxygen levels and photosynthesis; however, in this case the increased turbidity would not pose a significant impact, given its limited duration. Additionally, in coastal waters, suspension of bottom sediments is a natural occurrence with passing coastal storms. Construction of the landside facility is not expected to impair coastal water quality. | Not applicable  
Not applicable  
Not applicable  
Not applicable  
Not applicable  
Not applicable  
Not applicable  
Not applicable  
Not applicable  
Consistent  
Consistent  
Consistent |
### Table 4.7-1 (cont’d)
*State Coastal Zone Enforceable Policies*

<table>
<thead>
<tr>
<th>State Coastal Zone Enforceable Policies</th>
<th>Florida (cont’d)</th>
<th>South Carolina</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outdoor recreation and conservation lands</strong></td>
<td>The proposed action would not affect the development of a comprehensive multipurpose outdoor recreation plan that documents recreational supply and demand, describes current recreational opportunities, estimates need for additional recreational opportunities, and proposes means to meet the identified needs.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Pollutant discharge prevention and removal</strong></td>
<td>The proposed action at the NAVSTA Mayport landfall site would not result in the production of hazardous waste or the discharge of pollution.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Energy resources</strong></td>
<td>The proposed action would not affect energy resources.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Land and water management</strong></td>
<td>Action would occur primarily on federally owned lands; development of state lands would not occur; and areas of critical state concern or areas with approved state resource management plans would not be affected.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Public health, general provisions</strong></td>
<td>The proposed action does not involve the construction of an on-site sewage treatment and disposal system.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Mosquito control</strong></td>
<td>The proposed action would not affect mosquito control.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Environmental control</strong></td>
<td>Minimal, short-term impacts to water quality, and effects to ecological systems or air quality are not anticipated.</td>
<td>Consistent</td>
</tr>
<tr>
<td><strong>Soil and water conservation</strong></td>
<td>Soil and erosion control measures would be implemented per Naval Station Mayport procedures.</td>
<td>Consistent</td>
</tr>
<tr>
<td><strong>Cables, pipelines, and transmission lines</strong></td>
<td>Directional drilling to install the landside portion of the trunk cable to avoid wetlands and other critical areas.</td>
<td>Consistent</td>
</tr>
<tr>
<td><strong>Dredging and filling</strong></td>
<td>Use of ocean-bottom burial equipment to install the cable offshore of the landfall site.</td>
<td>Consistent</td>
</tr>
<tr>
<td><strong>Construction or repair of drives and parking lots</strong></td>
<td>Action would not involve constructing or repairing drives or parking lots seaward of the setback line or seaward of the baseline.</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Installation or repair of underground and overhead lines</strong></td>
<td>Action would not involve installing or repairing underground or overhead water, sewer, gas, electrical, telephone, or cable lines.</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
### Table 4.7-1 (cont’d)

#### State Coastal Zone Enforceable Policies

<table>
<thead>
<tr>
<th>State</th>
<th>Relevant Enforceable Policy</th>
<th>Analysis</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Carolina</td>
<td>Roads and highways</td>
<td>Action would not include construction of roads, highways, bridges, or transit facilities.</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>Parking facilities</td>
<td>Action would not include siting or construction of parking facilities.</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>Parks</td>
<td>Action would not include park development, construction of any park facilities, or the planning or design of parks and open space areas.</td>
<td>No applicable</td>
</tr>
<tr>
<td></td>
<td>Wildlife and fisheries management</td>
<td>As applicable, conservation measures would be implemented to minimize or eliminate the potential for adverse impact to the nesting activities of sea turtles during trunk cable installation. No lethal or long-term impact to fish.</td>
<td>Consistent</td>
</tr>
<tr>
<td></td>
<td>Dredging</td>
<td>Impacts to productive shellfish areas would be avoided or minimized during trunk cable burial. Cable burial would cause minimal, short-term impacts to water quality due to temporary disturbance of bottom sediments.</td>
<td>Consistent</td>
</tr>
<tr>
<td></td>
<td>Navigation channels</td>
<td>Directional drilling to install the landside portion of the trunk cable to avoid destruction of beach or dune vegetation. Soil and erosion control measures would be implemented.</td>
<td>Consistent</td>
</tr>
<tr>
<td></td>
<td>Public open space</td>
<td>Underground installation would not result in the destruction of beach or dune vegetation. Action would not limit public access to the beach.</td>
<td>Consistent</td>
</tr>
<tr>
<td></td>
<td>Stormwater runoff storage requirement</td>
<td>Navy would implement and maintain best management practices to minimize potential adverse impacts to water quality resulting from surface runoff.</td>
<td>Consistent</td>
</tr>
<tr>
<td></td>
<td>Project size requiring stormwater management permits</td>
<td>Navy would implement and maintain best management practices to minimize potential adverse impacts to water quality resulting from surface runoff.</td>
<td>Consistent</td>
</tr>
</tbody>
</table>
### Table 4.7.1 (cont’d)

**State Coastal Zone Enforceable Policies**

<table>
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<tr>
<th>State</th>
<th>Relevant Enforceable Policy</th>
<th>Analysis</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North Carolina</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoreline erosion</td>
<td>Directional drilling with sedimentation control techniques, no changes to topography.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Shoreline access</td>
<td>Onslow Beach is not available for use by the general public.</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Mitigation</td>
<td>Jurisdictional wetlands would be avoided, no impacts anticipated.</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>Coastal water quality</td>
<td>Temporary construction related turbidity, negligible metal contamination.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Coastal airspace</td>
<td>No change to existing airspace use.</td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td><strong>Estuarine and Ocean Systems</strong></td>
<td>Erosion and sedimentation control would minimize construction related impacts to estuarine and ocean systems.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td><strong>Ocean Hazard Areas</strong></td>
<td>The installation of the trunk cable does not constitute a structure; the CTF is located outside of the hazard area.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td><strong>Natural and Cultural Resource Areas</strong></td>
<td>Conservation measures currently in place, or to be determined through Section 7(a)(2) ESA consultation would be implemented to avoid impact of protected species and their habitat. No historical resources are present the proposed location of the trunk cable or CTF.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td><strong>Virginia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisheries management</td>
<td>No change to fisheries management program or initiatives. Any impacts to fish and their habitats would be insignificant.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Subaqueous lands management</td>
<td>Cable burial would cause minimal, short-term impacts to water quality due to temporary disturbance of bottom sediments.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Wetlands management</td>
<td>Directional drilling to avoid wetlands to the maximum extent practicable. If unavoidable, appropriate permits would be obtained prior to construction.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Dunes management</td>
<td>Primary sand dunes would not be altered or destroyed.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Non-point source pollution control</td>
<td>Sediment control measures would be utilized to minimize potential adverse impacts to water quality.</td>
<td>Consistent</td>
<td></td>
</tr>
<tr>
<td>Coastal lands management</td>
<td>Proposed action does not involve any activities in a designated Chesapeake Bay Preservation Area.</td>
<td>Not Applicable</td>
<td></td>
</tr>
</tbody>
</table>
4.8 Cumulative Impacts

The Navy’s past experience in preparing cumulative impacts analyses and the National Environmental Policy Act of 1969 (NEPA) were utilized in determining the scope and format of the cumulative impacts analyses presented within this subchapter of the Undersea Warfare Training Range (USWTR) Overseas Environmental Impact Statement/Environmental Impact Statement (OEIS/EIS).

The approach taken in the analysis of cumulative effects follows the objectives of NEPA, Council on Environmental Quality (CEQ) regulations, and CEQ guidance. CEQ regulations (40 Code of Federal Regulations [CFR] §§ 1500-1508) provide the implementing procedures for NEPA. The regulations define cumulative effects as:

“Cumulative impact” is the impact on the environment that 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 CFR 1508.7).”

“To determine the scope of environmental impact statements, agencies shall consider …[c]umulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.”

In addition, the CEQ has published guidance addressing implementation of cumulative impact analyses under NEPA. The CEQ guidance publication entitled Considering Cumulative Impacts Under the National Environmental Policy Act, January 1997 states that the analyses should:

“…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions... identify significant cumulative impacts…[and]…focus on truly meaningful impacts.”

Based on the guidance provided within this CEQ publication, the Navy has determined the following types of potential cumulative impacts need to be analyzed:

- Additive (the total loss of a resource from more than one incident),
- Countervailing (adverse impacts that are compensated for by beneficial effects), and
- Synergistic (when the total effect is greater than the sum of the effects taken independently).
However, the analysis of cumulative effects may go beyond the scope of project-specific direct and indirect effects to include expanded geographic and time boundaries and a focus on broad resource sustainability. The true geographic range of an action’s effect may not be limited to an arbitrary political or administrative boundary. Similarly, the effects of an action may continue beyond the time the action ceases. This “big picture” approach is becoming increasingly important as growing evidence suggests that the most significant effects result not from the direct effects of a particular action, but from the combination of individual, often minor, effects of multiple actions over time. The underlying issue is whether or not a resource can adequately recover from the effect of an action before the environment is exposed to a subsequent action or actions.

For the purposes of determining cumulative effects, the Navy reviewed all existing environmental documentation regarding current and planned actions associated with the resources analyzed in Chapter 4. Additionally, projects in the planning phase were also considered; only future actions that are reasonably foreseeable, not speculative, and that have the potential to interact with the proposed Navy action are addressed under cumulative impacts. Specific emphasis is placed on projects in and adjacent to each of the four alternative USWTR sites located along the east coast of the United States that involve components capable of generating in-water sounds given the proportion of effects analysis devoted to this issue. The level of information available for the different projects varies. The best available science is used in this analysis. The cumulative analysis incorporates specific numbers and values for potential effects, where available; descriptive information is used in place of quantitative measures where they are unavailable. Additionally, the National Marine Fisheries Service (NMFS) will review all associated actions and should be capable of identifying whether or not any critical stock may be endangered from the activities that would occur at the operationally preferred USWTR site alternative in the Jacksonville OPAREA.

4.8.1 Assumptions Used in the Analysis

The cumulative impacts analysis in this chapter differs from the analysis conducted for the USWTR site Alternatives detailed in Subchapters 4.1 to 4.6, because the cumulative impacts analysis considers an expanded geographic area and extended timeframe. Therefore, the cumulative impacts analysis includes additional effects on the physical, biological, and human environments associated with the USWTR range.

In accordance with NEPA, the cumulative impacts analysis takes into consideration combined effects of past, present, and reasonably foreseeable future activities. Therefore, the baseline utilized in the Alternatives analysis presented in Chapter 3 of this OEIS/EIS could not be used in the cumulative impacts analysis. The baseline associated with the cumulative impact analysis had to take into account the effects of both past and present activities. In accordance with NEPA, the cumulative impacts analysis must take into consideration the incremental contribution of the proposed action to the existing baseline. However, as activities increase within the study area,
the baseline will change. Thus, the baseline for the cumulative impacts analysis must include past, present, and reasonably foreseeable future activities.

The incremental contribution of the proposed action is relatively small and would most likely continue to reduce in size as non-military activities increase within the study area. Overall, it is more difficult to analyze cumulative impacts versus project-specific effects. The Navy recognizes the need to identify and quantify the factors causing the environmental change and the threshold triggers associated with the potential environmental response.

4.8.2 Sound in the Environment

4.8.2.1 Anthropogenic Sound

The potential cumulative impacts associated with active sonar activities focus on the addition of underwater sound to existing oceanic ambient noise levels, which in turn could have potential effects on marine animals. Anthropogenic sources of ambient noise that are most likely to contribute to increases in ambient noise levels are commercial shipping, offshore oil and gas exploration and drilling, and use of sonar (DoN, 2007b). The U.S. Navy does not anticipate the use of low-frequency sonar within the USWTR for the next five years; therefore, only the potential impact that mid- and high-frequency sonars may have on the overall oceanic ambient noise level is reviewed in the following contexts:

- Recent changes to ambient sound levels in the Atlantic Ocean
- Operational parameters of the sonar operating during USWTR activities, including proposed mitigation;
- The contribution of active sonar activities to oceanic noise levels relative to other human-generated sources of oceanic noise; and
- Cumulative impacts and synergistic effects.

Very few studies have been conducted to determine ambient sound levels in the ocean. In a study conducted by Andrew et al. (2002), oceanic ambient sound from the 1960s was compared to oceanic ambient sound from the 1990s using a receiver off the coast of California (DoN, 2007b). The data showed an increase in ambient noise of approximately 10 dB in the frequency range of 20 to 80 Hz and at 200 and 300 Hz, and about 3 dB at 100 Hz over a 33-year period (DoN, 2007b).

Anthropogenic sound can be introduced into the ocean by a number of sources, including vessel traffic, industrial operations onshore, seismic profiling for oil exploration, oil drilling, and sonar operations. In open oceans, the primary persistent anthropogenic sound source tends to be commercial shipping, since over 90 percent of global trade depends on transport across the seas.
Container shipping movements represent the largest volume of seaborne trade. Moreover, there are approximately 20,000 large commercial vessels at sea worldwide at any given time. The large commercial vessels produce relatively loud and predominately low frequency sounds. Most of these sounds are produced as a result of propeller cavitation (when air spaces created by the motion of propellers collapse) (Southall, 2005). In 2004, NOAA hosted a symposium entitled, “Shipping Noise and Marine Mammals.” During Session I, Trends in the Shipping Industry and Shipping Noise statistics were presented that indicate foreign waterborne trade into the U.S. has increased 2.45 percent each year over a 20 yr period (1981-2001) (Southall, 2005). International shipping volumes and densities are expected to increase in the foreseeable future (Southall, 2005). Although it is unknown how international shipping volumes and densities will continue to grow, current statistics support the prediction that the international shipping fleet will continue to grow at the current rate or at greater rates in the future. Shipping densities in specific areas and trends in routing and vessel design are as, or more, significant than the total number of vessels. Densities along existing coastal routes are expected to increase both domestically and internationally. New routes are also expected to develop as new ports are opened and existing ports are expanded. Vessel propulsion systems are also advancing toward faster ships operating in higher sea states for lower operating costs; and container ships are expected to become larger along certain routes (Southall, 2005). The increase in shipping volumes and densities will most likely increase overall ambient sound levels in the ocean. However, it is not known whether these increases would have an effect on marine mammals (Southall, 2005).

According to the NRC (2003), the oil and gas industry has five categories of activities which create sound: seismic surveys, drilling, offshore structure emplacement, offshore structure removal, and production and related activities. Seismic surveys are conducted using air guns, sparker sources, sleeve guns, innovative new impulsive sources and sometimes explosives, and are routinely conducted in offshore exploration and production operations in order to define subsurface geological structures. The resultant seismic data are necessary for determining drilling location and currently, seismic surveys are the only method to accurately find hydrocarbon reserves. Since the reserves are deep in the earth, the low frequency band (5 to 20 Hz) is of greatest value for seismic surveys, because lower frequency signals are able to travel farther into the seafloor with less attenuation (DoN, 2007b).

Air gun firing rate is dependent on the distance from the array to the substrate. The typical intershot time is 9 to 14 seconds, but for very deep water surveys, inter-shot times are as high as 42 sec. Air gun acoustic signals are broadband and typically measured in peak-to-peak pressures. Peak levels from the air guns are generally higher than continuous sound levels from any other ship or industrial noise. Broadband SLs of 248 to 255 dB from zero-to-peak are typical for a full scale array. The most powerful arrays have source levels as high as 260 dB, zero-to-peak with air gun volumes of 130 L (7,900 in³). Smaller arrays have SLs of 235 to 246 dB, zero-to-peak.

For deeper-water surveys, most emitted energy is around 10 to 120 Hz. However, some pulses contain energy up to 1,000 Hz (Richardson et al., 1995), and higher. Drill ship activities are one of the noisiest at-sea operations because the hull of the ship is a good transmitter of all the ship’s
internal noises. Also, the ships use thrusters to stay in the same location rather than anchoring. Auxiliary noise is produced during drilling activities from sources such as helicopters and supply boats. Offshore drilling structure emplacement creates some localized noise for brief periods of time, and emplacement activities can last for a few weeks and occur worldwide. Additional noise is created during other oil production activities, such as borehole logging, cementing, pumping, and pile-driving. Although sound pressure levels for the other activities have not yet been calculated, sound pressure levels for pile-driving have. More activities are occurring in deep water in the Gulf of Mexico and offshore West Africa areas. These oil and gas industry activities occur year-round (not individual surveys, but collectively) and are usually operational 24 hours per day and 7 days per week, as compared to the limited and intermittent sonar transmissions.

4.8.2.2 Cumulative Impacts from Use of Sonar

The potential for cumulative impacts and synergistic effects from all acoustic sources, including sonar, is analyzed in relation to overall oceanic ambient noise levels, including the potential for sound introduced by USWTR training to add to overall ambient levels of anthropogenic noise. Increases in ambient noise levels have the potential to cause masking, and decrease in distances that underwater sound can be detected by marine animals. These effects have the potential to cause a long-term decrease in a marine mammal’s efficiency at foraging, navigating, or communicating (DoN, 2007b). In addition, it is possible marine mammals will experience acoustically-induced stress (NRC, 2003). However, sounds resulting from one-time exposure are less likely to have population-level effects than sounds that mammals are exposed to repeatedly over extended periods of time (NRC, 2003).

Merchant ships and sound of seismic surveys cover a wide frequency band and are long in duration. The majority of proposed USWTR activity is away from harbors or heavily traveled shipping lanes. The loudest underwater sounds in the Proposed Action area are those produced by hull-mounted mid-frequency active tactical sonar. High-frequency sonar, specifically above 200 kHz, would dissipate rather quickly and is unlikely to impact marine mammals. Mid-frequency active sonar signals are likely within the audible range of most cetaceans, but are very limited in the temporal and frequency domains. In particular, the pulse lengths are short, the duty cycle low, and active sonars transmit within a narrow band of frequencies (typically less than one-third octave). Low-frequency sonar will not be used during USWTR activities.

NRC (2003) stated that although techniques are being developed to identify indicators of stress in natural populations, determining the contribution of noise exposure to those stress indicators will be very difficult, but important, to pursue in the future when the techniques are fully refined. There are scientific data gaps regarding the potential for active sonar to cause stress in marine animals. Even though an animal’s exposure to active sonar may be more than one time, the intermittent nature of the sonar signal, its low duty cycle, and the fact that both the vessel and animal are moving provide a very small chance that exposure to active sonar for individual animals and stocks would be repeated over extended periods of time, such as those caused by shipping noise. Since active sonar transmissions will not significantly increase anthropogenic oceanic noise, cumulative impacts and synergistic effects from stress are not reasonably foreseeable. Therefore, it is expected there would be a potential for minor incremental, but
recoverable, cumulative impacts to ambient ocean sound from implementation of activities on the USWTR when combined with the cumulative actions listed in this chapter.

4.8.3 Summary and Significance of Past Cetacean Stranding Events Related to Military Use of Sonar

Cetaceans face threats from a multitude of man-made sources (Geraci et al., 1999, NMFS 2007a), including intentional hunting, fishing gear entanglement, ship strikes (Laist et al., 2001), ensonification, pollution, habitat modification, gunshots, and toxic algal blooms. During the past 11 years, Navy sonar has been linked to only 5 stranding events, with a total of 51 stranded animals and 38 mortalities. The 38 mortalities equate to an average of approximately 3 cetacean mortalities per year over the past 11 years.

The majority of these five strandings are unique from other strandings because the stranding of whales occurred over a short period of time, stranded individuals were spatially co-located, traumas in stranded animals were consistent between events, and active sonar was known or suspected to be in use. Moreover, in several of these strandings, activities involved multiple ships operating in the same area over extended periods of time in close proximity. Furthermore, operations occurred across a relatively short horizontal distance, in areas surrounded by landmasses, and of at least 1 km (0.5 NM) in depth near a shoreline with a rapid change in bathymetry. In these cases, unique conditions may have existed in the active sonar activity area that, in their aggregate, may have contributed to the marine mammal strandings. However, these conditions are not present in the majority of other documented marine mammal strandings, and current science suggests that multiple factors, both natural and man-made, may be acting alone or in combination to cause marine mammals to strand.

Overall, the number of deaths associated with mid-frequency sonar exposure is small in comparison to the number of marine mammals killed annually through fishing by-catch and whaling operations (high-frequency sonar dissipates so quickly in water that no measurable impacts to marine mammals are anticipated). For example, a 2006 report by scientists from Duke University and the University of St. Andrews estimated that approximately 3,030 cetaceans die annually in U.S. waters as a result of by-catch (Read et al., 2006). When extrapolated to consider global impacts, the number increases to 308,000 deaths annually. In addition to by-catch, some countries still engage in whaling operations, whether under the guise of research or for commercial purposes. Such operations led to the death of approximately 560 cetaceans annually from 1986 through 2007 (International Whaling Commission [IWC], 2007). Thus, the overall contribution of cetaceans’ stranding resulting in death associated with exposure to Navy mid-frequency sonar is relatively small when compared to all the other non-military activity related to marine mammal stranding and effects, as shown in Figure 4.8-1.
The Navy has made the protection of marine mammals a top priority, and in conjunction with the National Oceanic and Atmospheric Administration (NOAA), has developed mandatory science-based mitigation measures that allow the Navy to conduct active sonar activities with the utmost care for the ocean environment.

For additional information on the marine mammal strandings, refer to Subchapter 3.2.6.5 and Appendix E.

### 4.8.4 Past and Present Actions

Various types of past and present actions not related to the Proposed Action have the potential to affect the resources identified in Chapter 3. The overview of these actions in this section emphasizes components of the activities that are relevant to the effects analysis in Chapter 4.
Geographic distribution, intensity, duration, and the historical effects of similar activities are considered when determining whether a particular activity may contribute cumulatively and significantly to the effects identified in Subchapters 4.1 to 4.6.

### 4.8.4.1 Commercial and Recreational Fishing

The fishing industry affects marine mammals and sea turtles. The National Oceanic and Atmospheric Administration (NOAA) estimates that approximately 6,000 marine mammals die annually as a result of by-catch from U.S. fisheries (Waring et al., 2002). Adverse effects to protected marine species are possible due to gillnet, longline, trawl gear, and pot fisheries. Additionally, commercial fisheries may accidentally entangle and drown or injure cetaceans by lost and discarded fishing gear (e.g., Northridge and Hofman, 1999). For example, entanglement in fixed fishing gear, in particular in sink gillnets and a variety of pot and trap fisheries, is one of the most important factors depressing the growth rate of the Atlantic Ocean right whale population (Kenney, 2002). Additionally, fisheries may indirectly compete with cetaceans by reducing the amount of primary food source accessible to cetaceans, thereby negatively affecting their numbers (Trites et al., 1997). Southeastern shrimp trawl and summer flounder/scup/black sea bass fisheries are considered to be most likely to adversely affect sea turtles; however, shrimp trawling has the greatest effect. The use of Turtle Excluder Devices (TEDs) in the shrimp fishery has reduced mortality by up to 50 percent. The implementation of new TED regulations is expected to further decrease mortality (NMFS, 2007f). Early examples of the success of TEDs, show that, within South Carolina waters, turtle mortality was reduced by approximately 44 percent in the first four years of mandatory TED use (Gibbons, 2008).

Fisheries are classified, first by addressing the total effect of all fisheries on each marine mammal stock, then second by addressing the effect of individual fisheries on each stock. This classification method includes consideration of the rate, in numbers of animals per year, of incidental mortalities and serious injuries of marine mammals due to commercial fishing operations relative to the potential biological removal (PBR) level for each stock (NMFS, 2007q). The PBR level is the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (NMFS, 2007q). Category I fisheries are the most detrimental to marine mammals and are defined as having an annual mortality and serious injury of a stock in a given fishery of greater than or equal to 50 percent of the PBR level (NMFS, 2007q). Table 4.8-1 shows the Category I commercial fisheries in the Atlantic Ocean and Gulf of Mexico and the marine mammal species affected.

About 13 million Americans participate in saltwater recreational fishing along and just off the U.S. coasts. In the past ten years, the number of recreational fishing trips has risen 10 percent to 82 million trips in 2003 (NMFS, 2005a). Nationwide, saltwater recreational fishing generates more than $30.5 billion annually and supports about 350,000 jobs (NMFS, 2005a).
Table 4-8-1
Category I Commercial Fisheries in the Atlantic Ocean and Gulf of Mexico

<table>
<thead>
<tr>
<th>Fishery Description</th>
<th>Estimated Number of Vessels/Persons</th>
<th>Marine Mammal Species Incidentally Killed/Injured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gillnet Fisheries</td>
<td>&gt;1,011</td>
<td>Fin whale</td>
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<td></td>
<td></td>
<td>Humpback whale</td>
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<td></td>
<td></td>
<td>Long-finned pilot whale</td>
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<td></td>
<td></td>
<td>Minke whale</td>
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<tr>
<td></td>
<td></td>
<td>Atlantic Ocean right whale</td>
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<tr>
<td></td>
<td></td>
<td>Short-finned pilot whale</td>
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<tr>
<td></td>
<td></td>
<td>Bottlenose dolphin</td>
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<tr>
<td></td>
<td></td>
<td>Common dolphin</td>
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<tr>
<td></td>
<td></td>
<td>Harbor porpoise</td>
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<td></td>
<td></td>
<td>Risso’s dolphin</td>
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<tr>
<td></td>
<td></td>
<td>White-sided dolphin</td>
</tr>
<tr>
<td>Longline Fisheries</td>
<td>94*</td>
<td>Cuvier’s beaked whale</td>
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<tr>
<td></td>
<td></td>
<td>Long-finned pilot whale</td>
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<tr>
<td></td>
<td></td>
<td>Mesoplodon beaked whale</td>
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<tr>
<td></td>
<td></td>
<td>Northern bottlenose whale</td>
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<td></td>
<td></td>
<td>Pygmy sperm whale</td>
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<tr>
<td></td>
<td></td>
<td>Short-finned pilot whale</td>
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<td>Atlantic spotted dolphin</td>
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<td>Bottlenose dolphin</td>
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<td>Common dolphin</td>
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<td></td>
<td></td>
<td>Pantropical spotted dolphin</td>
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<tr>
<td></td>
<td></td>
<td>Risso’s dolphin</td>
</tr>
<tr>
<td>Trap/Pot Fisheries</td>
<td>13,000</td>
<td>Fin whale</td>
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<tr>
<td></td>
<td></td>
<td>Humpback whale</td>
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<td>Minke whale</td>
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<tr>
<td></td>
<td></td>
<td>Atlantic Ocean right whale</td>
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</tr>
</tbody>
</table>

Source: NMFS, 2007a
*Some Caribbean fisheries are included in this number

4.8.4.1.1 Commercial and Recreational Fisheries – Atlantic Ocean, Offshore of the Southeastern United States

Fisheries off the southeastern U.S. Atlantic coast brought in over $344 million and about 290,000 metric tons (319,670 short tons) of catch in 2005 (NMFS, 2007a,b). Menhaden, flounder, mackerel, crab, sea scallops, and shrimp were the species caught that brought in the most money (NMFS, 2007c,d). Recreational fishing brought in approximately 37,052 metric tons (40,842 short tons) of fish in 2006 (NMFS, 2007k).

The SAFMC has recently designated eight marine protected areas (MPAs) along the southeastern coast of the U.S. as part of the South Atlantic snapper-grouper FMP (Federal Register, Vol. 74, No. 8, January 13, 2009). Designated MPAs occur within the proposed boundaries of Sites A and B (see Figure 3.2-1 and Figure 3.2-2). The MPAs are geographically defined areas of the marine environment where fishing or retention of snapper grouper species, and any deployment of shark-bottom longline fishing gear are prohibited (SAFMC, 2007c). The primary purpose of the MPAs is to protect the population of deepwater snapper-grouper species from fishing pressure to achieve a more natural sex ratio, age, size, and genetic structure (SAFMC, 2007c). Another
stated purposes of the MPAs is the protection of habitat and spawning areas of snapper grouper species since recent stock assessments have shown several snapper-grouper species to be overfished (SAFMC, 2005). Deepwater snapper grouper stocks are vulnerable to overfishing since they are long-lived, do not survive the trauma of capture from deep water, and may form large aggregations when reproducing (SAFMC, 2007c).

The Charleston Deep Artificial Reef MPA located in USWTR Site B is an experimental deepwater artificial reef MPA. The establishment of this deep artificial reef will facilitate research studies focused on answering questions about the practicability and effectiveness of deepwater artificial reefs. Once more research is conducted on this and other offshore artificial reefs, deploying additional materials to establish deepwater artificial reefs may be considered in a future amendment.

4.8.4.1.2 Commercial and Recreational Fisheries –Atlantic Ocean, Offshore of the Northeastern United States

Fisheries off the northeastern U.S. Atlantic coast brought in about $1.2 billion and over 400,000 metric tons (440,924 short tons) of catch in 2005 (NMFS, 2007e, f). The species that brought in the most money were Atlantic cod, flounder, goosefish, clams, American lobster, sea scallops, and crabs (NMFS, 2007g, h). Recreational fishing brought in roughly 6,745 metric tons (7,435 short tons) of fish in 2006 (NMFS, 2007i).

4.8.4.2 Minerals Management Service Regulated Activities: Oil and Gas

The Minerals Management Service (MMS) manages the mineral resources of the federal offshore lands of the Outer Continental Shelf (OCS). The MMS leases OCS lands to commercial companies for the exploration, extraction, and production of mineral resources. The Atlantic OCS area is divided into four planning areas along the Atlantic seaboard: the Atlantic Ocean, Mid-Atlantic, South Atlantic, and the Straits of Florida.

4.8.4.2.1 Exploration, Extraction, and Production of Oil, Gas, and Alternative Energy on the Outer Continental Shelf

The Minerals Management Service (MMS), within the Department of the Interior, manages the mineral resources of the federal offshore lands of the Outer Continental Shelf (OCS). MMS leases OCS lands to commercial companies for the exploration, extraction, and production of mineral resources. The Atlantic OCS area is divided into four planning areas along the Atlantic seaboard: the Atlantic Ocean, Mid-Atlantic, South Atlantic, and the Straits of Florida (MMS, 2007a).

For the past 26 years leasing of specific portions of the Federal OCS has been prohibited via the annual Congressional appropriations process (e.g. Congress not appropriating funds for MMS to conduct leasing for the specified OCS areas). From 1982 to 1992, Congress supported annual
moratoria in specific OCS areas off the coast of California, the North Atlantic, the Mid-Atlantic, the Eastern Gulf of Mexico and all of the North Aleutian Basin (EIA, 2005).

In 1990, President George H. W. Bush issued a Presidential Directive that enacted a blanket moratorium until 2000 on all unleased areas offshore Northern and Central California, Southern California except for 87 tracts, Washington, Oregon, the North Atlantic coast, and the Eastern Gulf of Mexico coast. Separate from the annual moratoria in appropriations legislation, this directive meant that no leasing or pre-leasing activities were allowed to occur in these areas during the entire period. In 1998, President Clinton extended the moratorium through 2012 (EIA, 2005).

On August 8, 2005, President George W. Bush signed into law the Energy Policy Act of 2005. This legislation has several provisions that pertain to natural gas and oil development including alternative energy related projects in offshore areas. Of note, the Act requires MMS to conduct a comprehensive inventory and analysis of the estimated natural gas and oil resources on the OCS. The inventory includes moratoria areas which were closed to natural gas and oil leasing. Several provisions in the Act provide increased incentives for natural gas and oil development in offshore areas in order to maintain and stimulate production. Finally, the Energy Policy Act of 2005 granted authority to MMS to manage and oversee alternative-energy related projects on the OCS. Prior to this provision, there was a gap in the law with respect to alternative energy projects (EIA, 2005).

In April 2007, MMS published the Proposed Final Program (PFP) OCS Oil and Gas Leasing Program 2007-2012 in conjunction with the FEIS for the 2007-2012 OCS Oil and Gas Leasing Program (MMS, 2007g,i). The FEIS evaluated the possible environmental affects of a proposed leasing program that includes the entire area offshore the coast of Virginia. With regard to potential interactions in this area, the Navy commented in 2006 on the Proposed Program for OCS Oil and Gas Leasing for 2007-2012 and the accompanying DEIS that it had concerns about possible operational conflicts with energy activities in this area. However, the Navy supported the 40 km (22 NM) buffer and no obstruction zone and expressed it willingness to discuss possible alternatives to minimize conflicts between energy development and military operations. In the PFP published in April 2007, MMS decided on one special interest sale in 2011, but with a 80-km (50-mi) buffer and a no obstruction zone from the mouth of the Chesapeake Bay off the coastline of Virginia. MMS also noted that the special lease sale in the Mid-Atlantic would only be held if the President chooses to modify the withdrawal and Congress discontinues the annual appropriations moratorium in the Mid-Atlantic.

In October 2007 MMS released a programmatic FEIS supporting the establishment of a program for authorizing alternative energy and alternate use (AEAU) activities on the Outer Continental Shelf (OCS), as authorized by Section 388 of the Energy Policy Act of 2005 (EPAct), and codified in subsection 8(p) of the Outer Continental Shelf Lands Act (OCSLA) (MMS, 2007j). The programmatic FEIS examines the potential environmental effects of the program on the OCS and identifies policies and best management practices that may be adopted for the program.
Under the program, MMS has jurisdiction over AEAU projects on the OCS including, but not limited to: offshore wind energy, wave energy, ocean current energy, offshore solar energy, and hydrogen generation. MMS will also have jurisdiction over other projects that make alternate use of existing oil and natural gas platforms in Federal waters on the OCS. Future AEAU activities on the OCS will be evaluated by the Navy on a case by case basis to determine if potential conflicts with Navy activities may exist in a specific area.

MMS issued the Record of Decision (ROD) to establish the AEAU program by selecting the preferred alternative described in the programmatic FEIS. This decision establishes an AEAU program for issuance of leases, easements, and rights-of-way (ROWs) on the OCS for alternative energy activities and the alternate use of structures on the OCS. The preferred alternative also provides MMS the option to authorize, on a case-by-case basis, individual AEAU projects that are in the national interest prior to promulgation of the final rule. At the same time, the MMS stated it would vigorously pursue its efforts to complete a comprehensive program with regulations for authorizing and managing AEAU activities on the OCS. Upon promulgation of the final rule, MMS leases, easements, and ROWs for AEAU activities on the OCS would be issued subject to the rule’s provisions. On July 9, 2008, MMS issued the proposed regulations for establishing a program to grant leases, easements, and rights-of-ways for alternative energy on the OCS. MMS is working toward issuance of several leases for data gathering and technology testing. These leases will look at varied renewable energy sources in different portions of the OCS (MMS, 2008). Additional information about this program can be found at the following Web site: http://ocsenergy.anl.gov/index.cfm.

On July 14, 2008, President Bush removed the executive prohibition on producing oil from the OCS that was in effect until 2012 and requested that Congress take action to lift the restrictions in order to give states the option to recommend the opening of the OCS off their coasts to environmentally responsible exploration (White House, 2008). In September 2008, the congressional ban on offshore drilling was allowed to expire (Washington Post, 2008).

Many Section 7 consultations have been completed on MMS activities. Until 2002, Biological Opinions (BOs) resulting from Section 7 consultations concluded that one take of sea turtles may occur annually due to vessel strikes. BOs issued on July 11, 2002 (lease sale 184), November 29, 2002 (multi-lease sales 185, 187, 190, 192, 194, 196, 200, and 201), and August 20, 2003 (lease sales 189 and 197), concluded that, in addition to vessel strikes to sea turtles, adverse effects may occur from seismic surveys and expended materials. Explosive removal of offshore structures may adversely affect sea turtles and marine mammals (U.S. Air Force, 2005b).

In April 2007, a final rule was published in the Federal Register by MMS requiring the lessees to provide information on how they will conduct their proposed activities in a manner consistent with ESA and MMPA (MMS, 2007k). Each lessee would be required to employ monitoring systems and mitigation measures, submit biological environmental reports and environmental effects analyses, and obtain its own authorized incidental “take” permits from NMFS (MMS, 2007k).
4.8.4.2.2 MMS Regulated Activities – Atlantic Ocean, Offshore of the Northeastern United States

The Atlantic Ocean Planning Area is composed of an area offshore that covers 373,930 km² (144,375 mi²) from Maine to New Jersey (MMS, 2007a). In 1979, 63 blocks (1,452 km² or 560 mi²) were leased (MMS, 2007b). However, there are currently no active leases and no activity in this area (MMS, 2007h).

4.8.4.2.3 MMS Regulated Activities – Atlantic Ocean, Offshore of the Southeastern United States

The Southeastern Atlantic Coast is divided by the MMS into three Planning Areas: Mid-Atlantic, South Atlantic, and Straits of Florida. These areas combined cover 715,970 km² (276,438 mi²) from Delaware to the southern most tip of Florida. From 1959 until 2000, 307 blocks (8,531 km² or 3,294 mi²) were leased (MMS, 2007b). There are currently no active leases and no activity in this area (MMS, 2007h). However, a special interest sale in the Mid-Atlantic region off the coast of Virginia has been proposed in late 2011 (MMS, 2007h).

4.8.4.3 State Regulated Oil and Gas Activities

The Submerged Lands Act of 1953 gives individual states the rights to marine natural resources from the coastline to no more than 5.6 km (3 NM) into the Atlantic Ocean and Gulf of Mexico. In Texas and the west coast of Florida, state jurisdiction extends from the coastline to no more than 16.2 km (3 marine leagues) into the Gulf of Mexico (MMS, 2007c). Natural resources beyond the above mentioned areas would be regulated by the MMS. Therefore, any oil or gas activities occurring within 5.6 km (3 NM) of the coast would be state regulated.

There are currently no state-regulated oil and gas activities within the Northeastern or Southeastern Atlantic Coast region of the United States (MMS, 2007h).

4.8.4.3.1 Onshore and Offshore Liquefied Natural Gas Facilities

Liquefied natural gas (LNG) is natural gas that has been cooled about -260 degrees Fahrenheit (°F) until the gas is in its liquid form. When natural gas is liquefied, it decreases to 1/600 its original volume, which makes it ideal for shipping (Federal Energy Regulatory Commission [FERC], 2005a). LNG is transported to LNG terminals by tankers equipped with insulated walls and systems to keep the LNG in liquid form. Once LNG is unloaded from ships at LNG terminals, it is stored as a liquid until it is warmed to convert it back to natural gas. The natural gas is then sent through pipelines for distribution (FERC, 2005a).

LNG is odorless, colorless, non-toxic, and will not burn as a liquid. LNG vapors will not explode in a confined environment and are only flammable at concentrations of 5 to 15 percent with air (FERC, 2005a). This makes LNG relatively harmless unless vapors are at flammable concentrations around an ignition source.
FERC, the USCG and the Maritime Administration (MARAD) regulate LNG facilities. LNG facilities that lie within state waters are regulated by FERC per the Energy Policy Act of 2005. The USCG and MARAD have jurisdiction over the LNG facilities within federal waters under the Federal Deepwater Ports Act of 1974 (FERC, 2006a).

4.8.4.3.2 Atlantic Ocean, Offshore of the Northeastern United States

There are currently no existing FERC or MARAD/USCG regulated LNG terminals offshore of the northeastern United States; however, two LNG terminals are located within water bodies adjacent to the Atlantic Ocean. Additionally, two terminals have been proposed and approved by MARAD/USCG offshore of Boston, Massachusetts (FERC, 2007).

*Dominion Cove Point LNG, LP – Cove Point, MD*

The Cove Point terminal began service in 1978 but was forced to close in 1980. In 1995, it was reopened to liquefy, store, and distribute domestic natural gas, and in July 2003 received its first LNG imports. The terminal is owned by Dominion Corporation and is located on the Chesapeake Bay, approximately 97 km (60 mi) southeast of Washington, DC (CRS, 2003). The demand for natural gas in the United States is expected to grow by at least 20 percent over the next decade (Dominion, 2007a). As a response to this increased demand, the FERC authorized the expansion of Cove Point LNG’s existing import terminal and pipeline, as well as the construction of new downstream pipeline and storage facilities as part of the Cove Point Expansion Project (FERC, 2006b). According to the Cove Point Expansion Project website, construction of the LNG facilities began in August of 2006. Pipeline facility construction began in 2007 and will continue through 2008. In the fall of 2008, it is expected to be ready for service (Dominion, 2007b).

4.8.4.3.3 Existing and Approved LNG Facilities, Nearshore Southeastern United States

There are currently no existing or approved FERC or MARAD/USCG regulated LNG terminals offshore of the southeastern United States (FERC, 2007).

4.8.4.4 Dredging Operations

The construction and maintenance of federal navigation channels are ongoing activities on the U.S. Atlantic coast. NMFS has identified dredging operations as an activity that can cause sea turtle mortality. Hopper dredges move faster than sea turtles and can entrain (or trap) them. NMFS has issued BOs with the U.S. Army Corps of Engineers (USACE) for the U.S. Atlantic coast and has concluded that the implementation of reasonable and prudent measures will result in no jeopardy to sea turtle species. Dredging activities also have the potential to affect the protected Gulf and shortnose sturgeons, particularly juveniles that may not be able to avoid entrainment. This potential effect has not been quantified. Dredging operations obviously affect the geology of an area, as the floor topography is altered and turbidity occurs.
An area in the mid-eastern Atlantic coast of the United States that utilizes maintenance dredging on a regular basis is the Hampton Roads region of southeastern Virginia. A Notice of Intent (NOI) to prepare an EIS for dredging the Norfolk Harbor Channel was announced in 2006. That EIS is being prepared so that 7.7 km (4.8 mi) of the channel could be deepened in order to provide naval carriers with safe and unrestricted access (DoN, 2006c). Hampton Roads, a natural tidal basin formed by the confluence of the James and Elizabeth Rivers, includes the waterways around Norfolk, Virginia Beach, Suffolk, Chesapeake, Portsmouth, Hampton, and Newport News, Virginia. A series of navigation channels (more than 10) lie in this area and require dredging to maintain their dimensions, which range from 107 to 305 m (350 to 1,000 ft) wide and 14 to 17 m (46 to 56 ft) deep (GlobalSecurity, 2005). The USACE Norfolk District has reported a total of 27 sea turtle takes between 2000 and 2006 due to dredging operations in the area of Hampton Roads (USACE, 2007c). Additional information about this project can be obtained from the following Web site: http://www.norfolkdredgingeis.com/EISDocuments.aspx.

A southeastern Atlantic coast region in which maintenance dredging is necessary is within Cumberland Sound and NSB Kings Bay on the southeastern Georgia coast. Dredging in Kings Bay has occurred at least once a year since 1994. The USACE Jacksonville District has reported a total of 15 sea turtle takes between 2000 and 2007 due to dredging operations in the Kings Bay area (USACE, 2007d).

### 4.8.4.5 Maritime Traffic

#### 4.8.4.5.1 Commerce/Shipping Lanes

The waters off the U.S. Atlantic coast support a large volume of maritime traffic heading to and from foreign ports as well as traffic traveling north and south to various U.S. ports. Commercial shipping comprises a large portion of this traffic, and a number of commercial ports are located along the Atlantic and Gulf of Mexico U.S. coasts.

One of the primary shipping lanes in the northeastern Atlantic coast area is off northern New England with many arteries leading to ports in Massachusetts, New Hampshire, and Maine. Most of the eastern portion of the Boston OPAREA is free from commercial traffic, but commercial traffic can be expected in the western part of the OPAREA (DoN, 2005a). Several primary shipping lanes crisscross the Narragansett Bay OPAREA, leading to the major ports of New York City, New York and Newark, New Jersey, as well as Providence, Rhode Island. The Atlantic City OPAREA contains several primary shipping lanes leading from New York City and Newark to ports in Delaware Bay and the mid-Atlantic United States (DoN, 2005a). On July 1, 2007, in order to reduce the threat of vessel collisions with right and other whale species, NOAA and the USCG implemented a shift in the traffic separation scheme for Boston. Ships going in and out of Boston Harbor via shipping lanes will now travel a path that is rotated slightly to the northeast and narrowed. This lane shift adds about 6.9 km (3.75 NM) to the overall shipping lane distance (NOAA, 2007a).
A number of commercial ports are located in Chesapeake Bay and Delaware Bay in the mid-Atlantic U.S. coast area. There also are a number of inland ports that are accessed through these bay systems (DoN, 2009g). The Virginia Capes (VACAPES) OPAREA is in the direct path of commercial shipping traffic traveling between the two major ports along the northeastern seaboard, New York and Boston, and Miami and other ports in the south (DoN, 2009g).

The Cherry Point and Jacksonville/Charleston (JAX/CHASN) OPAREAs are also in the direct path of commercial shipping traffic traveling between New York, Boston, and Miami and other ports in the southeast. There are seven major shipping lanes in the JAX/CHASN and Cherry Point OPAREAs. Most of the lanes are parallel to the coastline but several branch off the main routes where they approach major shipping ports (DoN, 2008l, n).

Marine transportation is expected to grow. Surface vessel traffic is a major contributor to noise in all oceans, particularly at low frequencies. The effect on marine species is unknown, but it is possible that this persistent noise may affect marine mammals’ use of sound for communication and hunting.

### 4.8.4.5.2 Ship Strikes

NMFS identified commercial and recreational traffic and recreational pursuits as potentially having adverse effects on sea turtles and cetaceans through propeller and boat strike damage (U.S. Air Force, 2004a). Private vessels participating in high-speed marine activities are particular threats.

Ship strikes or ship collisions with whales are a recognized source of whale mortality worldwide. The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). Laist et al. (2001) identified 11 species known to be hit by ships. Of these species, fin whales are struck most frequently; right whales, humpback whales, sperm whales, and gray whales are hit commonly. On the East Coast of North America, ship strikes remain a significant threat to some whale populations. For North Atlantic right whales, for example, ship strikes are believed to be a significant factor limiting the recovery of this species (Knowlton and Kraus, 2001).

A review of recent reports on ship strikes provides some insight regarding the types of whales, locations and vessels involved, but also reveals significant gaps in the data. The Large Whale Ship Strike Database report provides a summary of the 292 worldwide confirmed or possible whale/ship collisions from 1975 through 2002 (Jenson and Silber, 2004). The report also notes that these totals represent a minimum number of collisions, because the vast majority go undetected or unreported.

All types of ships can hit whales, and in most cases the animal is either seen too late, not observed until the collision occurs, or not detected. The ability of a ship to avoid a collision and
to detect a collision depends on a variety of factors, including environmental conditions, ship design, size, and manning.

Note that smaller ships, such as Navy destroyers and Coast Guard cutters, have a number of advantages for avoiding ship strikes compared to most merchant vessels. For instance, naval and Coast Guard ships have their bridges positioned forward, offering good visibility ahead of the bow.

Military crew sizes are also much larger than those of merchant ships, and they have dedicated lookouts posted during each watch. These vessels are generally twin screw and much more maneuverable than single screw commercial craft. Due to smaller ship size and higher deck manning, Navy and Coast Guard vessels are likely to detect any strike that does occur, and these agencies’ standard operating procedures include reporting of ship strikes. Overall, the percentage of Navy traffic relative to other large shipping traffic is very small (on the order of 2 percent).

NOAA continues to review all shipping activities and their relationship to cumulative effects, in particular on large whale species. According to the NOAA report (Jenson and Silber, 2004), the factors that contribute to ship strikes of whales are not clear, nor is it understood why some species appear more vulnerable than others. Nonetheless, the number of known ship strikes indicates that deaths and injuries from ships and shipping activities remain a threat to endangered large whale species, and to Atlantic Ocean right whales in particular (Jenson and Silber, 2004).

Maritime traffic also increases underwater noise. The amount of noise produced by a ship depends on its type, size, and operational mode. Large commercial vessels emit low frequency noise in ranges similar to those used by some large whales (mysticetes) in communication to each other (NMFS, 2006a). This communication between whales could be masked by vessel noise. Masking not only interferes with communication, but also with the animal’s ability to detect and avoid approaching ships (NMFS, 2006a). Masking can be due to one individual ship or the constant drone in the ocean from increases in boat traffic. Boat traffic has steadily increased over the years; however, the number of large ships is predicted to double over the next two to three decades (Southall, 2005).

**Implementation of Vessel Operational Measures to Reduce Ship Strikes to North Atlantic Right Whales**

In August 2008, NMFS released a Final EIS that analyzed the potential effects associated with the implementation of vessel operational measures in waters off the U.S. East Coast to reduce vessel collisions with the endangered North Atlantic right whale (NOAA, 2008c), followed by the Final Rule in October 2008 (NOAA, 2008d) enacting the rule from December 9, 2008 through December 9, 2013. The proposed action addresses the lack of recovery of the right whale population by reducing the probability and threat of ship strike related deaths and serious injuries to the species. Additional information about this action can be obtained from the following Web site: [http://www.nmfs.noaa.gov/pr/shipstrike](http://www.nmfs.noaa.gov/pr/shipstrike).
Due to regional differences in right whale distribution and behavior, oceanographic conditions, and ship traffic patterns; the proposed vessel operational measures would apply only in certain areas and at certain times of the year, or under certain conditions. To account for regional variations, the U.S. East Coast is divided into three regions: northeastern U.S. (NEUS), mid-Atlantic U.S. (MAUS), and southeastern U.S. (SEUS). All vessels 19.8 m (65 ft) and greater in overall length and entering or leaving a port or place subject to U.S. jurisdiction would be required to abide by the operational measures. The speed restrictions are not mandatory for naval vessels as stated by NMFS since it was recognized that national security, navigational, and human safety missions of some federal agencies may be compromised by mandatory vessel speed restrictions. The Navy currently implements mitigation measures to address ship strikes; and, NMFS has stated that most of these measures are similar to, if not more stringent than, the measures considered in the Final Rule. The measures included the following types of regulatory areas:

- **Seasonal Management Areas (SMAs).** SMAs are predetermined and established areas within which seasonal speed restrictions apply.

- **Dynamic Management Areas (DMAs).** DMAs are temporary areas consisting of a circle around a confirmed right whale sighting. The radius of this circle expands incrementally with the number of whales sighted and a buffer is included beyond the core area to allow for whale movement. Speed restrictions apply within DMAs, which may be mandatory or voluntary and apply only when and where no SMA is in effect.

When in effect, NMFS’ proposed speed restriction of 19 km/hr (10 kt) would be enforced within both the SMAs and DMAs. In broad terms (for details, see NOAA, 2008c), the regulations include:

- 20 NM areas from major MAUS ports and additional areas to 20 NM offshore centered of the coast of South Carolina and Rhode Island [In effect November 1 to April 30.

- A Southeast SMA over right whale calving habitat (effective November 15 to April 15).

- Three adjacent Northeast SMAs off the east coast of Massachusetts (in effect for different periods from January 1 to July 31)

- The potential for Voluntary DMAs to be established later.

It was determined that there would be a direct positive effect on right whale populations and indirect positive effects on marine mammals and sea turtles with the implementation of these rules (NOAA, 2008b). In addition, the rule is predicted to have a negligible impact on water quality in the NEUS, have minor adverse impacts in the SEUS, and minor positive effects to
ocean noise (NOAA, 2008b). There would be only minimal impact on the financial revenues of port vessel operators, commercial fishing vessels, and charter vessels (NOAA, 2008b). There would be annual financial adverse effects to ferry vessels and ferry passengers and whale-watching vessels. There were no environmental justice concerns identified and no effects to cultural resources (NMFS, 2008b).

The EIS analyzed potential effects to the North Atlantic right whale, other marine species, physical environment, port areas and vessel operations, commercial fishing vessels, ferry vessels and ferry passengers, whale-watching vessels, charter vessels, environmental justice, and cultural resources. For the purposes of the cumulative impacts analysis in this EIS/OEIS, the preferred alternative, Alternative 6, will be discussed. It was determined that there would be a direct positive effect on right whale populations and indirect positive effects on marine mammals and sea turtles. In addition, implementation of Alternative 6 would result in negligible impacts on water quality in the NEUS had minor adverse impacts in the SEUS, as well as minor, direct positive effects to ocean noise. There would be only minimal impact on the financial revenues of port vessel operators, commercial fishing vessels, and charter vessels. There would be annual financial adverse effects to ferry vessels and ferry passengers and whale-watching vessels. There were no environmental justice concerns identified and no effects to cultural resources (NOAA, 2008c).

In addition, in July 2007, the east-west leg of the Boston Traffic Separation Scheme was shifted approximately 12 degrees north. The desired effect of this change is to redirect shipping traffic through the Stellwagen Bank NMS from an area of high whale density to an area of significantly lower whale density (NOAA, 2008b). Further traffic changes are possible to prevent ship strikes.

4.8.4.6 Scientific Research and Seismic Surveys

Scientific research on protected species such as marine mammals and sea turtles and studies on the marine environment in general occur throughout the Atlantic Ocean. For targeted research on particular species regulated by NMFS and the USFWS, a scientific research and enhancement permit is required for any proposed research activity that involves the “take” of a marine species (NMFS, Undated). Scientific Research and Enhancement Permits are required for research that results in the take of marine mammal species or involves any ESA-listed species that are not covered by the General Authorization. Permits cover a five-year period. The most recent permit was issued by NMFS in August 2007 and includes the observation of behavioral responses by beaked whales and other odontocetes to underwater sound. The permit, which covers activities being conducted by NMFS’s Office of Science and Technology, authorizes research on marine mammals in waters to the east of Andros Island, Bahamas. Activities include the attachment of tags to and photography of cetaceans, and exposing them to sound, particularly from mid-frequency sonar. Additional permits authorized that are of particular interest to the Navy include a wide variety of research activities on right whales. NMFS is currently analyzing the cumulative effects of these authorizations in the proposed Programmatic EIS on Northern Right Whale Research.
The 1994 amendments to the MMPA authorized, under a General Authorization, the conduct of activities that involve low-impact harassment levels of marine mammals in the wild. Activities encompassed by the General Authorization for Scientific Research do not require a scientific research and enhancement permit. The activities covered under the General Authorization are limited to bona fide research that only involves Level B harassment of non-ESA-listed marine mammals and generally include, but are not limited to, photo-identification studies, behavioral observations, vessel surveys, and aerial surveys over water or land, as well as over pinniped rookeries if flown at altitudes greater than 305 m (1,000 ft) (NMFS, 1994a). In addition to the General Authorization, NMFS also issues commercial and education photography permits. These permits allow for photography of non-listed marine mammals that result at a maximum in Level B harassment. Additional activities authorized include those related to imports for public display of marine mammals, as well as import and export of marine mammal parts.

Seismic surveys occur throughout the OPAREAs. One of the most active organizations performing oceanographic seismic surveys is the Lamont-Doherty Earth Observatory (LDEO). Seismic surveys performed by LDEO utilize airguns, sonar, and sub-bottom profilers, all of which have the possibility of harassing marine mammals. The OCS Deep Water Royalty Relief Act (DWRRA) provides economic incentives for operators to develop fields in water depths greater than 200 m (656 ft).

The potential exists for effects to protected marine mammals and sea turtles from underwater noise associated with seismic airgun surveys. LDEO has had Incidental Harassment Authorizations (IHAs) for surveys off the mid- and northwest Atlantic Ocean, as well as the northern Yucatan Peninsula, northern Gulf of Mexico, and southeast Caribbean Sea (NMFS, 2003d, 2004b, c). However, these IHAs are all now expired. NMFS has determined that minor adverse behavioral effects to sea turtles may result from seismic survey activities in deeper federal waters, but these effects would be short-term and minor. Effects to sea turtles have not yet been analyzed in states where nesting beaches and important foraging areas may be present (U.S. Air Force, 2005b).

4.8.4.7 Environmental Contamination and Biotoxins

Insufficient information is available to determine how, at what levels, or in what combinations, environmental contaminants may affect cetaceans (Marine Mammal Commission [MMC], 2003). There is growing evidence that high contaminant burdens are associated with several physiological abnormalities, including skeletal deformations, developmental effects, reproductive and immunological disorders, and hormonal alterations (Reijnders and Aguilar, 2002). DeSwart et al. (1996) conducted a study where harbor seals were fed contaminated Baltic herring and their immune function was monitored over a two-and-a-half-year period. The results of this study showed that chronic exposure to environmental contaminants accumulated through the food chain had an adverse effect on the immune function of those harbor seals. This further suggests that environmental contaminants may have an adverse immunological effect on free-ranging seals in areas with similar contamination levels as that observed in this study (DeSwart et al., 1996). Since no similar studies have been conducted with other marine mammal species, it
may be reasonably concluded that similar effects could occur in other marine mammals, such as cetaceans.

Several mortality activities (die-offs) have been reported for cetaceans. Biotoxins, viruses, bacteria, and El Niño activities have been implicated separately in recent mass mortality activities (Domingo et al., 2002). A mass mortality activity for humpback whales, apparently associated with biotoxins, occurred along the beaches of Massachusetts in 1987 through 1988. Geraci et al. (1989) concluded that the whales died from saxitoxin poisoning after consumption of Atlantic mackerel containing the toxin. During the summer of 2003, 17 humpback whales, 3 fin whales, 1 minke whale, 1 long finned pilot whale, and 3 whales of undetermined species were found dead in the vicinity of Georges Bank. Although a biotoxin (saxitoxin) was found in several samples collected, it was not present at lethal levels. Domoic acid was also detected and suspected as a probable cause, but because no brain samples were collected, the role of this biotoxin could not be confirmed (MMC, 2004; DoN, 2005a).

4.8.4.8 Marine Ecotourism (Whale- and Dolphin-Watching)

Migrating baleen whales may be affected by whale-watching activities off the East Coast as well as in the Caribbean (Hoyt, 1995). Effects of whale-watching on cetaceans may be measured in a short time-scale (i.e., startle reaction) or as a long-term effect on reproduction or survivability (International Fund for Animal Welfare [IFAW], 1995). There is little evidence to show that short-term effects have any relation to possible long-term effects on cetacean individuals, groups, or populations (IFAW, 1995). Whale-watching could have an effect on whales by distracting them, displacing them from rich food patches, or by dispersing food patches with wake or propeller wash.

4.8.4.9 National Aeronautics and Space Administration (NASA) Activities

The National Aeronautics and Space Administration’s (NASA’s) main operational centers on the East Coast are located at Kennedy Space Center and Cape Canaveral Air Force Station in Florida and Wallops Flight Facility/Goddard Space Flight Center in Virginia. NASA will periodically, and with prior coordination, require the airspace be cleared for a launch event. This is normally a two hour window after which the airspace is returned to FFJ. Activities at the Florida sites in 2007 and 2008 include five space shuttle launches, and four Delta II rocket launches (NASA, 2007a).

NASA Wallops Flight Facility located on Virginia’s Eastern Shore is NASA’s principal facility for management and implementation of suborbital research programs. The Wallops facility manages the NASA sounding rocket and scientific balloon operations. The Sounding Rocket Program conducts launches worldwide and provides an effective and inexpensive means of gathering data about the atmosphere and space. Scientific balloons provide a cost effective means for scientific investigations of the atmosphere, solar system and the rest of the universe. While carrying instrumentation up to 3,628 kg (8,000 lbs), the balloons can fly to altitudes up to 33.8 km (23 mi) for a duration of a few hours to more than two weeks.
An EA was completed in 2003 which proposed to make available for use the AQM-37 at Wallops Island (NASA, 2003). The AQM-37 is an air-launched, preprogrammed, nonrecoverable target with external command and control capabilities which can be used as an aerial target to test new and operational ship defense weapon systems. The purpose of the AQM-37 is to serve as a target for missile exercises being performed by the DoN and supported by WFF in the VACAPES OPAREA. This would be used to test the performance of shipboard weapons systems as well as provide simulated real-world targets for ship defense training exercises, allowing for the potential requirement of 20 target flights per year with a maximum of 30, which have been in place since 2003. After analyzing 14 environmental resources (land resources, water resources, air quality, noise, hazardous materials and waste, biological resources, population, recreation, employment and income, health and safety, cultural resources, environmental justice, transportation, and cumulative effects), NASA determined that there were no significant environmental impacts from the AQM-37 operations at WFF (NASA, 2003). Additional information about this project can be found at the following Web site: http://sites.wff.nasa.gov/code250/docs/wff_aqm-37_fea.pdf.

Finally, NASA Wallops Flight Facility participates in the development and testing of instruments for orbital flight by conducting observational Earth Science studies, supporting aerospace technology development, providing aircraft flight services for scientific investigations, operating the Wallops Test Range and managing the Orbital Tracking Station. The Test Range consists of a rocket launch range, aeronautical research airport and associated tracking, data acquisition and ordnance operations. Suborbital and orbital vehicles are launched from Wallops Island. No major launches are planned for Wallops Flight Facility/Goddard Space Flight Center. (NASA, 2007b). Wallops Orbital Tracking Station provides around the clock tracking, command and data acquisition operations. The mission support set includes many of NASA’s low Earth orbiting spacecraft and NASA cooperative spacecraft, plus Department of Defense, commercial and foreign spacecraft.

4.8.4.10 Military Operations

4.8.4.10.1 Sinking Exercise of Surface Targets

A Sinking Exercise of Surface Targets (SINKEX) is defined as the use of a vessel as a target or test platform against which live ordnance is fired. The purpose of a SINKEX is to train personnel, test weapons, and study the survivability of ship structures. The result is the sinking of the vessel. SINKEX operations differ from ship shock trials in that the warheads used in a SINKEX are significantly smaller. The environmental considerations of a SINKEX are associated with the weapons used. The exact amount of ordnance and the type of weapon used in a SINKEX is situational and training-need dependent (DoN, 2006d).

The potential expended materials created during a SINKEX are metals from the sunken vessel and shell fragments. Disposable plastics and other materials that could be considered marine debris are removed from the vessel prior to conducting a SINKEX. Expended material associated with the target vessel would not include ropes, lines, plastic or other materials with the potential
to ensnare or entangle marine animals. All expended materials would sink rapidly to the ocean floor and since SINKEXs would not be continuously conducted within the same areas, the sunken debris would settle over a large area. The minimal amount of materials settling to the ocean floor would not affect the sediment stability of the ocean floor or cause disturbance to natural ocean processes (DON, 2006d).

In the late 1980’s, Polychlorinated biphenyls (PCBs) were raised as a potential environmental issue. Some of the materials (i.e., insulation, wiring, felts and rubber gaskets) present on the targeted vessels were confirmed to contain PCBs. As a result, the Navy removes the majority of the materials containing PCBs prior to conducting a SINKEX event. However, it is estimated that, even after removal activities, any given target vessel sunk during a SINKEX could still contain up to 45 kg (100 lbs) of PCBs. In an effort to determine if the remaining PCBs would be an environmental issue, the Navy began conducting a PCBs monitoring study in 1995 on sunken Navy vessels. The monitoring study has not been completed but as of November 2006 it was determined that enough data had been gathered and transferred to the EPA to indicate that there was little likelihood that PCBs from sunken Navy vessels would present an unacceptable risk to the environment or human health. The Navy SINKEX Program currently holds a General Permit from the EPA under the Marine Protection, Research and Sanctuaries Act for conducting SINKEX activities (40 CFR 229.2).

The DoN submitted a Biological Assessment (BA) to the National Oceanic and Atmospheric Administration (NOAA) pursuant to compliance with the ESA. NOAA concluded that SINKEXs in the western Atlantic Ocean are not likely to jeopardize the continued existence of ESA listed species in a Biological Opinion dated September 22, 2006 (DoN, 2006d).

**4.8.4.10.2 Military Operations – Atlantic Ocean**

Designated bomb boxes have been established in each OPAREA where inert bombs could be dropped during a major Atlantic Fleet training exercise. The process for selecting these sites within each OPAREA involved balancing operational suitability (close proximity to where the strike group is operating) and environmental suitability. Environmental suitability includes an area that possesses a low likelihood of encountering threatened and endangered species and that avoids the continental shelf, canyon areas, and the Gulf Stream, all of which are locations where threatened and endangered marine mammal and sea turtle species are most abundant. The use of the bomb box (Area J31) in the JAX/CHASN OPAREA is discussed in the 1997 NMFS BO, which concludes that Navy activities are not likely to jeopardize the continued existence of listed species (NMFS, 1997). Based on the combination of prudent site-selection and the mitigation measures to be implemented in all OPAREAs that were developed as part of the BO for protection of the North Atlantic right whale (NMFS, 1997), it is anticipated that dropping inert bombs in the established bomb boxes associated with major Atlantic Fleet exercises would not affect listed species.
VACAPES Range Complex

The VACAPES Range Complex [OPAREA and associated landside facilities] is the primary homeport of the Atlantic Fleet and is the principal training area for air, surface, and submarine units located in Hampton Roads, Virginia. VACAPES Range Complex operations include aircraft training; surface training; subsurface training; and research, development, testing and evaluation (RDT&E) of emerging technologies (DoN, 2009h). The objective of the VACAPES Range Complex is to provide sustainable and modernized ocean operating areas, airspace, ranges, range infrastructure, training facilities, and resources to fully support the Navy’s training requirements.

The VACAPES Range Complex geographically encompasses offshore, near-shore, and onshore OPAREAs, ranges, and Special Use Airspace (SUA) located along the eastern coasts of Virginia and North Carolina that act as a set of operating and maneuver areas with defined ocean surface and subsurface areas. The surface water areas of the range complex include the coasts of Delaware, Maryland, Virginia, and North Carolina, encompassing 94,996 km² (27,661 NM²). The seaward areas extend 287 km (155 NM) offshore, while the shoreward extent of the OPAREA is roughly aligned with the 5.6 km (3 NM) state territorial limits.

Training operations in the VACAPES Range Complex vary from unit-level exercises to integrated, major, range training events. A description of non-ASW training operations typically conducted in the VACAPES Range Complex can be found in Table 4.8-2. The Navy proposes to increase and modify training and RDT&E operations from current levels in support of the FRTP, accommodate mission requirements associated with force structure changes, including those resulting from the introduction of new platforms (aircraft and weapons systems), and implement enhanced range complex capabilities in the VACAPES Range Complex. The purpose for the Navy’s proposed action in the VACAPES Range Complex is to:

- Achieve and maintain Fleet readiness using the VACAPES Range Complex to support and conduct current, emerging, and future training and RDT&E operations;
- Expand warfare missions supported by the VACAPES Range Complex; and
- Upgrade and modernize existing range capabilities to enhance and sustain Navy training and RDT&E.

The Navy released the Final EIS/OEIS for the VACAPES Range Complex in March 2009 to assess the potential environmental effects in the range complex over a 10-year planning horizon (The VACAPES Range Complex Final EIS/OEIS is incorporated in this Final OEIS/EIS by reference and is available from the following Web site: http://www.vacapesrangecomplexeis.com/). The EIS/OEIS compared three alternatives: two alternatives involving changes to the training schedule, and a No Action Alternative (implementation of which would continue the training schedule unchanged from the current schedule, including surge capabilities, consistent with the Fleet Response Training Plan [FRTP]).
The Navy’s preferred alternative was Alternative 2: Increases and Modifications in Operational Training, Accommodate Force Structure Changes, and Implement Enhancements.

The preferred alternative predicts an increased number of training events, while enhancing mine warfare training capabilities and reducing the number of BOMBEX training events that involve dropping live, high-explosive ordnance on targets at-sea (DoN, 2009i). The preferred alternative would implement enhancements to the minimal extent possible to meet the components of the FRTP to implement the FRP. It would also increase operational training, expand warfare missions, and accommodate force structure changes, which would include changing weapon systems and platforms, and homebasing new aircraft and ships in the range complex, as well as increase mine warfare training capabilities, and establish MIW training areas with small fields of mine shapes, and implementation of additional enhancements to enable the range complex to meet future requirements (DoN, 2009i). Mine detection sonar will be used in these exercises, description of this software and its use is covered under the AFAST Final EIS/OEIS (DoN, 2008h). (The AFAST Final EIS/OEIS is incorporated in this Final OEIS/EIS by reference and is available from the following Web site: http://afasteis.gcsaic.com/index.aspx.)

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. It was determined that there would be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the VACAPES Range Complex under the preferred alternative. Additional information about this project can be obtained from the following Web site: http://www.vacapesrangecomplexeis.com/EIS.aspx.

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles in response to the preferred alternative. Refer to Chapter 3 of the VACAPES Range Complex Final EIS/OEIS (DoN, 2009i) for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 2,472 total marine mammals per year (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment, [reduced from 63,664 under the No Action Alternative]. Acoustic analysis also indicates that 25 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment [reduced from 728 under the No Action Alternative]. The analysis calculated that one marine mammal mortality may also result [reduced from seven under the No Action Alternative]. The results also indicate the quantity of ESA-listed sea turtles that may be exposed to levels of sound: 1,513 individuals may be subject to non-injurious harassment [reduced from 11,340, under the No Action Alternative], 15 may result in injurious harassment [reduced from 97, under the No Action Alternative], and none will result in mortality [reduced from 2, under the No Action Alternative].
Table 4.8-2.

VACAPES Range Complex Typical Operations (Non-ASW)

<table>
<thead>
<tr>
<th>Range Operation</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Mine Warfare (MIW)</strong></td>
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</tr>
<tr>
<td>Mine countermeasures exercise</td>
<td>These exercises train forces to detect, identify, classify, mark, avoid, and disable (or verify destruction of) sea mines using a variety of methods, including, air, surface, and subsurface assets.</td>
</tr>
<tr>
<td>Mine neutralization</td>
<td>These operations involve the detection, identification, evaluation, rendering safe, and disposal of underwater unexploded ordnance (UXO) that constitute a threat to ships or personnel.</td>
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<tr>
<td><strong>Surface Warfare (SUW)</strong></td>
<td></td>
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<tr>
<td>Bombing exercise (BOMBEX) (sea)</td>
<td>These exercises allow aircrew to train in the delivery of bombs against maritime targets.</td>
</tr>
<tr>
<td>Missile exercise (MISSILEX) (air-to-surface)</td>
<td>These exercises use laser and live fire to train fixed-wing aircraft and helicopter aircrews in the delivery of optical, infrared seeking, or laser guided missiles at surface targets.</td>
</tr>
<tr>
<td>Gunnery exercise (GUNEX) (air-to-surface)</td>
<td>Gunnery exercises train fixed-wing aircraft and helicopter aircrews to attack surface targets at sea using guns.</td>
</tr>
<tr>
<td>GUNEX (surface-to-surface) (boat)</td>
<td>In these exercises, small boat gun crews train by firing against surface targets at sea.</td>
</tr>
<tr>
<td>GUNEX (surface-to-surface) (ship)</td>
<td>Ship gun crews in these exercises train by firing against surface targets at sea.</td>
</tr>
<tr>
<td>Laser targeting</td>
<td>Laser targeting exercises are used to train aircraft personnel in the use of laser targeting devices to illuminate designated targets for engagement with laser-guided weapons.</td>
</tr>
<tr>
<td><strong>Visit, Board, Search, and Seizure/Maritime Interdiction Operations (VBSS/MIO)-Ship</strong></td>
<td>Crews from Navy helicopters and surface ships identify, track, intercept, board and inspect foreign merchant vessels suspected of not complying with United Nations/allied sanctions and/or conflict rules of engagement. The boarding party will be delivered from a surface ship via Rubber-hull Inflatable Boat (RHIB) or similar small craft if the target vessel is non-hostile, or via helicopter if hostile. This training event is non-firing.</td>
</tr>
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Table 4.8-2 (cont’d)

VACAPES Range Complex Typical Operations (Non-ASW)

<table>
<thead>
<tr>
<th><strong>Air Warfare (AW)</strong></th>
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<tbody>
<tr>
<td>Air combat maneuver (ACM)</td>
<td>ACM is the general term used to describe an air-to-air event involving two or more aircraft, each engaged in continuous proactive and reactive changes in aircraft attitude, altitude, and airspeed. No weapons are fired during ACM operations.</td>
</tr>
<tr>
<td>GUNEX (air-to-air)</td>
<td>In these training operations, guns are fired from aircraft against unmanned aerial target drones.</td>
</tr>
<tr>
<td>MISSILEX (air-to-air)</td>
<td>These are training operations in which air-to-air missiles are fired from aircraft against unmanned aerial target drones such as BQM-34 and BQM-74.</td>
</tr>
<tr>
<td>GUNEX (surface-to-air)</td>
<td>These operations are conducted by surface ships with 5-inch, 76 mm, and 20 mm Close-In Weapons System. Targets include unmanned drones or targets towed behind aircraft.</td>
</tr>
<tr>
<td>MISSILEX (surface-to-air)</td>
<td>These operations train surface ship crews in defending against airplane and missile attacks with the ship’s missiles. Missile firing ships, including guided missile cruisers, frigates, and destroyers, armed with surface-to-air missiles are required to engage each of three different presentations of aerial threats once per FRTP. The targets used are BQM-34, BQM-74, and GQM-163 Coyote.</td>
</tr>
<tr>
<td>Air intercept control</td>
<td>Surface ship and fixed-wing aircraft crew train in using their search radar capability to direct strike fighter aircraft toward threat aircraft.</td>
</tr>
<tr>
<td>Detect-to-engage</td>
<td>Shipboard personnel use all shipboard sensors (search and fire control radars and Electronic Support Measures (ESM)) in the entire process of detecting, classifying, and tracking enemy aircraft and/or missiles up to the point of engagement, with the goal of destroying the threat before it can damage the ship.</td>
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<tr>
<th><strong>Strike Warfare (STW)</strong></th>
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<tr>
<td>High-Speed Anti-Radiation Missile Exercise (HARMEX) (air-to-surface)</td>
<td>Aircrews train in the use of High-Speed Anti-Radiation Missiles (HARM), the primary weapon designed to target anti-aircraft missile sites.</td>
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<tr>
<th><strong>Amphibious Warfare (AMW)</strong></th>
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<tr>
<td>Firing exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)</td>
<td>FIREXs with IMPASS are training operations that direct naval gunfire to strike land targets and support military operations ashore. This training is conducted at-sea using a buoy system that simulates a land mass that a ship fires on using IMPASS.</td>
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<th><strong>Electronic Combat (EC)</strong></th>
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<tr>
<td>Chaff exercise</td>
<td>Chaff exercises train aircraft and shipboard personnel in the use of chaff to counter missile threats. Training and testing events are not necessarily dedicated sorties, but are combined with other exercises.</td>
</tr>
<tr>
<td>Flare exercises</td>
<td>These exercises train aircraft personnel in the use of flares for defensive purposes when countering heat-seeking missile threats. Training and testing events are not necessarily dedicated sorties, but are combined with other exercises.</td>
</tr>
<tr>
<td>Electronic combat operations</td>
<td>Ship-borne electronic combat operations or command and control warfare attempts to control critical portions of the electromagnetic spectrum.</td>
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<tr>
<th><strong>Test and Evaluations</strong></th>
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<tbody>
<tr>
<td>Shipboard Electronic Systems Evaluation Facility (SESEF) utilization</td>
<td>SESEF operations test ship antenna radiation pattern measurements and communication systems.</td>
</tr>
</tbody>
</table>
The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2009h). In addition, these exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and/or sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal and/or sea turtle species or populations.

In accordance with 50 CFR § 402.11, after reviewing the current status of the endangered North Atlantic right whale, humpback whale, sei whale, fin whale, blue whale, sperm whale, loggerhead sea turtle, Kemp’s ridley sea turtle, leatherback sea turtle, Atlantic green sea turtle, and hawksbill sea turtle, the environmental baseline for the VACAPES study area, the effects of the proposed action, and the cumulative effects, NMFS issued a Programmatic Biological Opinion on June 5, 2009 concluding that the Navy’s proposal to conduct testing and training activities in the VACAPES study area each year for a 5-year period beginning in June 2009 is likely to adversely affect but is not likely to jeopardize the continued existence of these threatened and endangered species under NMFS’ jurisdiction. NMFS also concluded that the effects of the proposed action are not likely to result in the destruction or adverse modification of critical habitat that has been designated for endangered or threatened species in the action area. Consultation with NMFS was considered complete on June 5, 2009 when NMFS issued both the Programmatic Biological Opinion and an Annual Biological Opinion for the period from June 2009 to June 2010.

In accordance with regulations under Section 7 of the ESA (50 CFR Part 402), the Navy requested informal consultation with USFWS on May 12, 2008 for the potential effects of the proposed action on Bermuda petrel, Florida scrub-jay, red-cockaded woodpecker, roseate tern, wood stork, West Indian manatee (including designated critical habitat), American alligator, eastern indigo snake, sand skink, pondberry, clasping warea, Lewton’s polygala, and scrub buckwheat. In a letter dated October 7, 2008, the USFWS concurred with the Navy’s determination that the preferred alternative will have no effect on or is not likely to adversely affect the federally-listed species or designated critical habitat.

NMFS issued final regulations and an LOA on June 5, 2009 in accordance with the MMPA to authorize the incidental take of marine mammals that may result from the implementation of the activities analyzed in the VACAPES Final EIS/OEIS.

**Navy Cherry Point Range Complex**

Due to the Navy’s training requirements, the objective of the Cherry Point Range Complex is to provide sustainable and modernized ocean operating areas, airspace, ranges, range infrastructure, training facilities, and resources to fully support the Navy’s training requirements. It is a centrally located between the Atlantic Fleet concentration areas in Hampton Roads, Virginia and Jacksonville, Florida, and the Marine Forces Atlantic concentrations areas in North Carolina, making it the primary venue for all levels of amphibious training and intermediate and advanced
levels of CSG, ESG, and MEU training (DoN, 2009j). A description of non-ASW training operations typically conducted in the Cherry Point Range Complex can be found in Table 4.8-3.

Table 4.8-3.
Cherry Point Range Complex Typical Operations (Non-ASW)

<table>
<thead>
<tr>
<th>Range Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mine Warfare (MIW)</strong></td>
<td></td>
</tr>
<tr>
<td>Mine countermeasures (MCM)</td>
<td>Helicopters, surface and subsurface units detect, identify, classify, mark, disable and/or destroy sea mines using a variety of methods.</td>
</tr>
<tr>
<td>Mine neutralization</td>
<td>Helicopters, surface, and subsurface units, and EOD personnel identify, evaluate, localize and destroy or render safe sea mines that constitute a threat to ships, landing craft or personnel.</td>
</tr>
<tr>
<td><strong>Surface Warfare (SUW)</strong></td>
<td></td>
</tr>
<tr>
<td>Bombing Exercise (Sea) (BOMBEX A-S)</td>
<td>Fixed wing aircraft deliver bombs against maritime targets.</td>
</tr>
<tr>
<td>Missile Exercise (Air-to-Surface)</td>
<td>Air-to-Surface Missile Exercise (Laser and Live Fire) [MISSILEX (A-S)] trains fixed-wing aircraft and helicopter aircrews in the delivery of optical, infrared seeking or laser guided missiles at surface targets.</td>
</tr>
<tr>
<td>Gunnery Exercise (Air-to-Surface)</td>
<td>Air-to-Surface Gunnery Exercise (GUNEX) trains fixed-wing aircraft and helicopter aircrews to attack surface targets at sea using guns.</td>
</tr>
<tr>
<td>Gunnery Exercise Ship (Surface-to-Surface) (GUNEX S-S (Ship))</td>
<td>Surface ships fire main battery guns and crew-served weapons against maritime targets.</td>
</tr>
<tr>
<td>Visit, Board, Search, and Seizure/Maritime Interdiction Operations (VBSS/MIO)-Ship and Helo</td>
<td>Crews from Navy helicopters and surface ships identify, track, intercept, board and inspect foreign merchant vessels suspected of not complying with United Nations/allied sanctions and/or conflict rules of engagement. The boarding party will be delivered from a surface ship via Rubber-hull Inflatable Boat (RHIB) or similar small craft if the target vessel is non-hostile, or via helicopter if hostile. This training event is non-firing.</td>
</tr>
<tr>
<td><strong>Air Warfare (AW)</strong></td>
<td></td>
</tr>
<tr>
<td>Air Combat Maneuver (ACM)</td>
<td>Two or more aircraft engaged in continuous proactive and reactive changes in aircraft attitude, altitude, and airspeed in an attempt to destroy the opposition. Fighter aircraft do fire live weapons during ACM, just not in a training environment.</td>
</tr>
<tr>
<td>GUNEX (Air-to-Air)</td>
<td>GUNEX Air-to-Air training operations in which guns are fired from aircraft against unmanned aerial target drones.</td>
</tr>
<tr>
<td>MISSILEX (Air-to-Air)</td>
<td>Air-to-Air Missile Exercise [MISSILEX (A-A)] are training operations in which air-to-air missiles are fired from aircraft against unmanned aerial target drones such as BQM-34 and BQM-74.</td>
</tr>
<tr>
<td>Air Intercept Control (AIC)</td>
<td>Surface ships vector friendly aircraft to intercept and destroy adversary aircraft.</td>
</tr>
</tbody>
</table>
### Table 4.8-3 (cont’d)

Cherry Point Range Complex Typical Operations (Non-ASW)

<table>
<thead>
<tr>
<th><strong>Electronic Combat (EC)</strong></th>
<th><strong>Strike Warfare (STW)</strong></th>
<th><strong>Amphibious Warfare (AMW)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electronic Combat Operations (EC)</strong></td>
<td><strong>High-Speed Anti-Radiation Missile Exercise (HARMEX) (air-to-surface)</strong></td>
<td><strong>Firing Exercise (FIREX)-Land (FIREX (Land))</strong></td>
</tr>
<tr>
<td>Aircraft, surface ships, and submarines attempt to control critical portions of the electromagnetic spectrum to degrade or deny the enemy’s ability to defend its forces from attack and/or recognize an emerging threat early enough to take the necessary defensive actions.</td>
<td>Aircraft crews train in the use of High-Speed Anti-Radiation Missiles (HARM), the primary weapon designed to target anti-aircraft missile sites.</td>
<td>Surface ships fire main battery guns against land targets in support of military operations ashore.</td>
</tr>
<tr>
<td><strong>Chaff Exercise</strong></td>
<td><strong>Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)</strong></td>
<td><strong>Amphibious Assault</strong></td>
</tr>
<tr>
<td>Ships and aircraft deploy chaff to disrupt threat targeting and missile guidance radars and to defend against an attack.</td>
<td>This training is conducted at-sea using a computer simulated land target and a series of buoys that can acoustically score the training event.</td>
<td>A Marine Battalion Landing Team (typically two reinforced companies, including armor and service support units) move ashore from the Expeditionary Strike Group at-sea to establish a beachhead in hostile territory, then moves further inland for an extended period. Ingress via amphibians, landing craft and/or rotary-wing aircraft. Coordinated fire support from aircraft, surface ships and artillery.</td>
</tr>
<tr>
<td><strong>Flare Exercise</strong></td>
<td></td>
<td><strong>Firing Exercise (FIREX)-Land (FIREX (Land))</strong></td>
</tr>
<tr>
<td>Aircraft deploy flares to disrupt threat infrared guidance systems of threat missiles.</td>
<td></td>
<td>Surface ships fire main battery guns against land targets in support of military operations ashore.</td>
</tr>
<tr>
<td><strong>Amphibious Raid</strong></td>
<td></td>
<td><strong>Amphibious Raid</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A reinforce company (100-150 Marines) makes a swift, short-term incursion from the Expeditionary Strike Group at-sea to a hostile area ashore for a specified purpose and a specified time, then makes a planned withdrawal. Ingress and extraction via small boats, amphibians, landing craft and/or helicopters.</td>
</tr>
</tbody>
</table>
The Cherry Point Range Complex geographically encompasses offshore and near-shore OPAREAs, instrumented ranges, and SUA located. This complex is located along the eastern coasts of North Carolina and South Carolina. The Cherry Point Range Complex is a set of operating and maneuver areas with defined ocean surface and subsurface areas. The surface water area of the range complex covers the coast of North Carolina, encompassing 63,936 km² (18,617 NM²). The shoreward extent of the range complex is roughly aligned with the 5.6 km (3 NM) state territorial limits.

The Navy released the Final EIS/OEIS in April 2009 to assess the potential environmental impact for future activities in the Cherry Point Range Complex over a 10-year planning horizon (The Cherry Point Range Complex Final EIS/OEIS is incorporated in this Final OEIS/EIS by reference and is available from the following Web site: http://www.navycherrypointrangecomplexes.com/.) The EIS/OEIS compared three alternatives: two alternatives involving changes to the training schedule, and a No Action Alternative, (implementation of which would continue the training schedule unchanged from the current schedule, including surge capabilities, consistent with the Fleet Response Training Plan [FRTP]). The Navy’s preferred alternative was identified as Alternative 2, which included all operations under Alternative 1 plus eliminating all high explosive at-sea BOMBEXs and designating two mine warfare training areas for major exercise mine training events.

Under the preferred alternative, the Navy would continue conducting current activities as well as enhancing range complex operations and capabilities to address emerging and foreseeable future Navy and DoD training and RDT&E requirements. The preferred alternative allows for an across-the-board increase in most operations to provide the Navy and Marine Corps with flexibility to train for real world situations, plus change in type and quantity of operations and tactical employment of forces to accommodate expanded mission areas, force structure changes, and new range capabilities.

The preferred alternative would also eliminate all high explosive (HE) bombing exercises at-sea (BOMBEX Air-to-Surface) and designate two mine warfare (MIW) training areas for major exercise MIW events. Mine detection sonar will be used and use of this sonar is covered within the AFAST Final EIS/OEIS (DoN, 2008h). With the elimination of HE BOMBEX, the Navy and Marine Corps plan to continue to drop Non-Explosive Practice Munitions (NEPMs or inert bombs) (DoN, 2009j). Furthermore, the Navy intends to perform mine neutralization operations for both ESG and CSG major exercises in the area currently designated for underwater detonation (UNDET) training, 5.6 to 22.2 km (3 to 12 NM) off the coast in the Cherry Point OPAREA (DoN, 2009j).

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. The Navy determined that there will be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the Cherry Point Range Complex (DoN, 2009j).
As a result of early discussions with the NMFS Southeast Regional Office (SERO), Habitat Conservation Division (HCD), it was determined that the agency was most concerned with potential impacts of military operations to sensitive habitats such as live/hard bottom, the proposed deepwater coral HAPC, and the recently established deepwater snapper-grouper MPAs. As part of the Cherry Point Range Complex EIS/OEIS, the Navy determined that based on the distribution of these sensitive habitats, it is possible that a small percentage of NEPMs would strike in these areas. The potential for strikes to adversely affect benthic communities in these areas would depend on the substrate and community types found at the point of physical impact. Given the dispersed nature of the training activities, often patchy distribution of community types, and relatively limited bottom mapping data, it was not possible to accurately determine the number of NEPMs that would strike soft bottom habitats versus more sensitive areas such as live/hard bottom. Nonetheless, NEPMs could result in 582 m² (6,266 ft²) of disturbance to benthic habitats per year, of which only a percentage of the total benthic area affected, less than 582 m² (6,266 ft²) per year, would be sensitive benthic habitat such as live/hard bottom or coral mounds. Based on geographic data obtained through SAFMC, the study area contains about 2,965 km² (865 NM²) of live/hard bottom EFH. Assuming a worst-case scenario where all of the NEPMs were to settle in areas of live/hard bottom, the total benthic habitat affected represents less than 0.0000196 percent of the total live/hard bottom EFH in the study area. In addition, the probability of this event occurring was calculated to be approximately 5.35 x 10⁻¹⁶². As a result, the Navy concluded that NEPM strikes could result in long-term, minor effects to benthic EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to benthic EFH would be minimal based on the relatively small area affected by non-explosive practice bombs. Given the small area affected, NEPM use under the selected alternative presented in the Cherry Point Range Complex EIS/OEIS would not reduce the quality and/or quantity of EFH in the study area.

During the development of the Navy Cherry Point Range Complex EIS/OEIS, NMFS SERO HCD identified concerns over potential impacts on EFH from Navy training activities, specifically potential impacts from expended materials disturbing live/hardbottom habitats such as deepwater corals. The Navy and NMFS SERO HCD further discussed the NMFS concern and concluded: (1) NMFS SERO HCD and the Navy have a mutual interest in understanding the potentially effected environment and the impacts of current and proposed Navy activities; (2) the spatial extent of the impacts to live/hardbottom habitats cannot be determined at this time based on the best available information; and (3) it is not feasible to forecast exact locations where the expended materials will settle upon the seafloor. As a result of the concerns expressed by NMFS SERO HCD and the above conclusions reached by both agencies, NMFS and the Navy agreed to further collaborate to establish an approach for improving coordination on data collection efforts and sharing such data to the extent national security and other Navy restrictions allow. As data collection and other research results in new habitat data, the Navy will continue to reassess and incorporate such information into future environmental planning for the Cherry Point Range Complex. This approach may include: (1) NMFS SERO HCD identifying specific, finite areas of known or potential deepwater habitats of concern; (2) the Navy providing the areas where current/proposed activity would result in high use of expended materials that could potentially disturb bottom habitats; and (3) NMFS SERO HCD and the Navy agree to further assess those
areas in future environmental planning documents once areas of overlap are identified. In a letter dated May 28, 2009, NMFS SERO HCD memorialized its concern regarding potential impacts, recorded the Navy and NMFS agreement on the approach identified above, and acknowledged that the procedural goals for implementing the EFH requirements of the Magnuson-Steven Act were satisfied for Navy’s training activities in the Cherry Point Range Complex and that EFH conservation recommendations were not needed. A copy of this letter can be found on the project website at http://www.navycherrypointrangecomplexesis.com.

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles as a result of the activities being performed by the preferred alternative. Refer to Chapter 3 of the Navy Cherry Point Range Complex Draft EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that two marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment [reduced from 2,876 under the No Action Alternative]. No marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment [reduced from 65 under the No Action Alternative]. The results also indicate that no ESA-listed sea turtles would be exposed to levels of sound likely to result in any level of harassment [reduced from 137 non-injurious harassments and 3 injurious harassments under the No Action Alternative].

The exposure estimates represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2009j). In addition, these exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and/or sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal species or populations.

In accordance with 50 CFR § 402.11, after reviewing the current status of the endangered North Atlantic right whale, humpback whale, sei whale, fin whale, blue whale, sperm whale, loggerhead sea turtle, Kemp’s ridley sea turtle, leatherback sea turtle, Atlantic green sea turtle, and hawksbill sea turtle, the environmental baseline for the Navy Cherry Point Range Complex study area, the effects of the proposed action, and the cumulative effects, NMFS issued a Programmatic Biological Opinion on June 5, 2009 concluding that the Navy’s proposal to conduct testing and training activities in the Navy Cherry Point Range Complex study area each year for a 5-year period beginning in June 2009 is likely to adversely affect but is not likely to jeopardize the continued existence of these threatened and endangered species under NMFS’ jurisdiction. NMFS also concluded that the effects of the proposed action are not likely to result in the destruction or adverse modification of critical habitat that has been designated for endangered or threatened species in the action area. Consultation with NMFS was considered complete on June 5, 2009 when NMFS issued both the Programmatic Biological Opinion and an Annual Biological Opinion for the period from June 2009 to June 2010.

In accordance with regulations under Section 7 of the ESA (50 CFR Part 402), the Navy requested informal consultation with USFWS on May 12, 2008 for the potential effects of the proposed action on Bermuda petrel, Florida scrub-jay, red-cockaded woodpecker, roseate tern,
wood stork, West Indian manatee (including designated critical habitat), American alligator, eastern indigo snake, sand skink, pondberry, clasping warea, Lewton’s polygala, and scrub buckwheat. In a letter dated October 7, 2008, the USFWS concurred with the Navy's determination that the Preferred Alternative will have no effect on, or is not likely to adversely affect the federally-listed species or designated critical habitat.

NMFS issued final regulations and an LOA on June 5, 2009 in accordance with the MMPA to authorize the incidental take of marine mammals that may result from the implementation of the activities analyzed in the Navy Cherry Point Range Complex Final EIS/OEIS.

**MCB Camp Lejeune and MCAS Cherry Point**

DoN has two installations located on land adjacent to the Cherry Point OPAREA, Marine Corps Air Station (MCAS) Cherry Point, and Marine Corps Base (MCB) Camp Lejeune. These installations often use the waters of the OPAREA for training operations. The Cherry Point OPAREA is host to activities for RDT&E of emerging maritime combat technologies. MCAS Cherry Point, located about 145 km (90 mi) southwest of Cape Hatteras in North Carolina, is the world’s largest MCAS, covering over 117 km² (45 mi²). Military activities at MCAS Cherry Point revolve around training and support for air combat operations associated with the 2nd Marine Aircraft Wing. Camp Lejeune, within Onslow County, is the Marine Corps’ largest amphibious training facility. Camp Lejeune is a 637 km² (246 mi²) military training facility that includes 23 km (14 mi) of beach capable of supporting amphibious operations. It is home to the II Marine Expeditionary Force, 2nd Marine Division, 2nd Force Service Support Group, and other combat units and support commands. Camp Lejeune contains 54 live-fire ranges, 89 maneuver areas, 33 gun positions, 25 tactical landing zones, and a Military Operations in Urban Terrain (MOUT) training facility. Military forces from around the world come to Camp Lejeune on a regular basis for bilateral and North Atlantic Treaty Organization (NATO)-sponsored exercises. Training operations in the Cherry Point Range Complex can vary from unit level exercises to integrated major range training events. A description of non-ASW training operations typically conducted in the Cherry Point Range Complex can be found in Table 4.8-4 (from DoN, 2009j).

**MCAS Cherry Point**

NMFS issued a BO (NMFS, September 2002) in response to a BA sent by MCAS Cherry Point for the continued use of Bombing Target 9 (BTar-9) and BTar-11 in Pamlico Sound, North Carolina. The BO covers the use of BTar-9 and BTar-11 by various military aircraft and small watercraft training in ordnance delivery. In addition, non-explosive ordnance up to 907 kg (2,000 lbs), strafing rounds, and explosive ordnance (not to exceed 45 kg [100 lbs] trinitrotoluene [TNT] equivalent) are covered at BTar-9. Only non-explosive ordnance is authorized at BTar-11.

The BO states NMFS’s belief that the use of explosive and non-explosive ordnance at BTar-9 and non-explosive ordnance at BTar-11 is not likely to jeopardize the continued existence of loggerhead, Kemp’s ridley, green, or leatherback sea turtles. However, NMFS anticipates incidental takes of these species and has issued an ITS pursuant to Section 7 of the ESA. This
ITS contains reasonable and prudent measures with implementing terms and conditions to help minimize takes.

Due to the pre-deployment training schedules associated with emerging missions, including Operation Enduring Freedom and Operation Iraqi Freedom, there is a need to increase the operational training tempo at the MCAS Cherry Point Range Complex. Moreover, increased training is needed to address foreseeable increases in the number of military personnel training at MCAS Cherry Point. Given these aspects, MCAS Cherry Point proposes to take action that would provide a training environment within the MCAS Cherry Point Range Complex with the capacity and capability to fully support required training tasks for operational units, military schools, and other users.

The Marine Corps prepared an EA (DoN, 2009b) in accordance with the NEPA to assess the environmental impact of training operations in the MCAS Cherry Point Range Complex. The proposed action is to support and conduct current and emerging training operations at the range complex. Under the proposed action, there would be increases in current training operations at existing ranges. These training operations would be conducted within existing special use airspace and on existing land and water ranges within the range complex. The EA compared three alternatives: two alternatives involving changes to the training, and a No Action Alternative, implementation of which would continue the current level of training operations. The Marine Corps’ preferred alternative was identified as Alternative 2. Alternative 2 would provide the current level of training operations within the MCAS Cherry Point Range Complex that occur under the No Action Alternative plus additional training increases in sortie operations and munitions usage associated with rotary-wing aircraft (AH-1, CH-53, and UH-1) squadrons and a 10–20 percent increase in small arms range activities, as well as establishment of a water restricted area at BTar-11 for intermittent use in support of a proposed change in small arms live-fire training.

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects training operations would cause. It was determined that there would be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the MCAS Cherry Point Range Complex ((DoN, 2009b).

The Marine Corps prepared a Marine Mammal Compliance Report (DoN, 2009e) in accordance with the MMPA to analyze the potential effects to marine mammals associated with implementing Alternative 2. The Marine Mammal Compliance Report addressed those training missions occurring on the water ranges or with impact areas over the water because of their potential to affect marine mammals. These include the following:

- Munitions firing – Units conduct air-to-ground, surface-to-ground, and air-to-surface at targets that are located on land or in water.
- Small boat maneuvers – Units operate various types of rigid hulled and rubber hulled vessels. These boats use inboard or outboard engines with either propeller or water jet propulsion.

The report addressed potential impacts to marine mammal species or stocks from underwater noise, inert munitions, and small boat maneuvers. Acoustic analysis indicated that there would be a potential for 9 exposures of bottlenose dolphins to sound levels likely to result in Level B harassment. Less than 1 (0.5) bottlenose dolphins would be exposed to sound levels likely to result in Level A harassment and less than 1 (0.11) bottlenose dolphin would be exposed to sound levels likely to result in mortality.

The Marine Mammal Compliance Report also analyzed the probability of direct strike from inert munitions. The analysis indicated that the potential risk of a direct hit to a marine mammal in the target area is so low it is discountable. It would take approximately three years of ordnance deployment at the bombing targets before it would be likely or probable that one bottlenose dolphin would be struck by deployed inert ordnance.

The Marine Corps analyzed the potential of amphibious operations and small boat maneuvers to disturb or collide with marine mammals within the study area. The analysis indicated that bottlenose dolphin are not likely to be injured or killed as a result of small boats operating at high speeds, because of the dolphin’s high swimming speed and its ability to maneuver around moving vessels. Because the West Indian manatee rarely occurs within the study area, the likelihood of an encounter with a small boat is very low.

Training for amphibious landing is restricted at Camp Lejeune because of beach restrictions during turtle-nesting season, and a rare species of woodpecker makes inland training difficult. A loggerhead turtle nesting site is next to Camp Lejeune. North Carolina law protects the Atlantic sturgeon, American shad, green turtle, loggerhead sea turtle, and Kemp’s ridley turtle. The loggerhead and green turtles are also federally listed threatened species, and the Kemp’s ridley turtle is federally listed as an endangered species.

**MCB Camp Lejeune**

USFWS issued a BO (USFWS, May 2002) in response to a BA sent by MCB Camp Lejeune for the continued use and modification of designated military training areas on Onslow Beach, dune stabilization in the central and military training portions of the beach, and the continued recreational use of the beach. The BO addressed the effects of these actions on seabeach amaranth (*Amaranthus pumilus*), the loggerhead sea turtle and green sea turtle, and the Great Lakes, Atlantic Coast, and Northern Great Plains piping plover (*Charadrius melodus*) populations.

This BO states USFWS’s belief that the continued use and modification of training areas, dune stabilization, recreational use of Onslow Beach, and the cumulative effects, are not likely to jeopardize the continued existence of seaside amaranth, loggerhead and green sea turtles, or the
piping plover. However, USFWS anticipates incidental takes of sea turtles and piping plovers, and has issued an ITS pursuant to Section 7 of the ESA. This ITS contains reasonable and prudent measures with implementing terms and conditions to help minimize takes.

Due to the pre-deployment training schedules associated with emerging missions, there is a need to increase the operational training tempo at the MCB Camp Lejeune Range Complex. Moreover, increased training is needed to address foreseeable increases in the number of military personnel training at MCB Camp Lejeune. Given these aspects, MCB Camp Lejeune proposes to take action that would provide a training environment within the MCB Camp Lejeune Range Complex with the capacity and capability to fully support required training tasks for operational units, military schools, and other users.

The Marine Corps prepared an EA (DoN, 2009c) in accordance with the NEPA to assess the environmental impact of training operations in the MCB Camp Lejeune Range Complex. The proposed action is to support and conduct current and emerging training operations within the range complex. The proposed action includes all current training activities and levels, as well as increases in the following:

- 20% increase in small arms training, except .50 caliber arms.
- Increase in rotary-wing (helicopter) operations including:
  - 33% increase in CH-53 sorties.
  - 100% increase in AH-1 and UH-1 sorties.
- 10% increase in training with MK-19 40-millimeter grenade rounds.
- 5% increase in training with artillery, mortar, and other large arms.
- 39% increase in training with tank rounds.
- 33% increase in tactical vehicle operations.

The Marine Corps prepared a Marine Mammal Compliance Report (DoN, 2008k) in accordance with the MMPA to analyze the potential effects to marine mammals associated with implementing the proposed action. Water ranges within the MCB Camp Lejeune Range Complex (DoN, 2009c).

The EA compared one action alternative and a No Action Alternative, implementation of which would continue the current level of training operations.

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects training operations would cause. It was determined that there would be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the MCB Camp Lejeune Range Complex (DoN, 2009c).

The Marine Corps prepared a Marine Mammal Compliance Report (DoN, 2008k) in accordance with the MMPA to analyze the potential effects to marine mammals associated with implementing the proposed action. Water ranges within the MCB Camp Lejeune Range Complex (DoN, 2009c).
Complex considered in the analysis were the New River, AIWW, Onslow Bay, and Atlantic Ocean. The Marine Mammal Compliance Report addressed those training missions occurring on the water ranges or with impact areas over the water because of their potential to affect marine mammals. These include the following:

- Munitions firing – Units conduct ground-to-ground, surface-to-ground, surface-to-surface, and ground-to-air firing at targets that are located on land or in air but have impact areas and surface danger zones that include water.

- Amphibious operations – Amphibious operations deal with the movement of personnel and equipment from ships at sea to the shore/beach area before further inland movement by ground or air methods. Amphibious operations are also conducted on the New River and at sea independently of larger Naval vessels. Amphibious movement is typically done with the amphibious ships’ landing craft and Marine Corps amphibious vehicles.

- Small boat maneuvers – Units operate various types of rigid hulled and rubber hulled inflatable vessels in inland and offshore waters.

The report addressed potential impacts to marine mammal species or stocks from underwater noise, inert munitions, and small boat maneuvers. Acoustic analysis indicated that there would be a potential for less than 1 (0.35) exposure of a bottlenose dolphin to sound levels likely to result in Level B harassment. Less than 1 (0.07) Atlantic spotted dolphins would be exposed to Level B noise. Acoustic analysis indicated that no bottlenose dolphins or Atlantic spotted dolphins would be exposed to sound levels likely to result in Level A harassment or mortality.

The Marine Mammal Compliance Report also analyzed the probability of direct strike from inert munitions. The analysis indicated that there would be a potential for less than 1 direct strike of a bottlenose dolphin – 0.03 in the New River during winter or summer, 0.06 in Onslow Bay during winter, and 0.02 in Onslow Bay during summer. The analysis also indicated a potential for less than 1 (0.01) direct strike of a spotted dolphin in Onslow Bay year round. Impacts to manatee, humpback whale, and right whale could not be calculated since their occurrence within the study area is so low. Given that their occurrence is lower than the bottlenose dolphin which had a very low probability of impact, the Marine Corps assumed that the potential for a direct strike on manatee, humpback whales, and right whales would be even less.

The Marine Corps analyzed the potential of amphibious operations and small boat maneuvers to disturb or collide with marine mammals within the study area. The analysis indicated that bottlenose dolphin are not likely to be injured or killed as a result of amphibious operations inshore, as amphibious vessels within the inshore areas operate at relatively slow speeds and would not pose a collision risk to bottlenose dolphins. A low risk of collision exists between the North Atlantic right whale and vessels operating within the Onslow Bay portion of the BTar-3 Impact Area. Likewise, the risk of impact to manatees in the study area was determined to be low.
MCB Camp Lejeune prepared two BAs (DoN, 2009d, 2009f) for implementation of the proposed action within the MCB Camp Lejeune Range Complex. The BAs addressed the effects of the proposed action on federally-listed threatened and endangered species, and critical habitat under the jurisdiction of the NMFS and the USFWS. Critical habitat does not occur within the action area and, therefore, would not be affected. With respect to species under the jurisdiction of the NMFS, the Marine Corps has determined that implementation of the proposed action within the action area would have no effect on the hawksbill sea turtle and shortnose sturgeon, and may affect, but is not likely to adversely affect the loggerhead sea turtle, leatherback sea turtle, Kemp’s ridley sea turtle, green sea turtle, North Atlantic right whale, and humpback whale. With respect to species under the jurisdiction of the USFWS, the Marine Corps has determined that implementation of the proposed action within the action area may affect, but is not likely to adversely affect seabeach amaranth, rough-leaved loosestrife (Lysimachia asperulaefolia), nesting leatherback sea turtles, and West Indian manatee. The BA was provided to USFWS to initiate formal Section 7 consultation regarding likely adverse effects on nesting loggerhead sea turtles and green sea turtles, red-cockaded woodpeckers, and piping plovers.

**JAX Range Complex**

The JAX Range Complex is the principal training area for air, surface, and submarine units located in Charleston, South Carolina; Kings Bay, Georgia; and Jacksonville, Florida. In addition to serving as the site for essential Navy training, the range complex is host to activities for RDT&E of emerging maritime and combat technologies. The objective of the JAX Range Complex is to provide sustainable and modernized ocean operating areas, airspace, ranges, range infrastructure, training facilities, and resources to fully support the Navy’s training requirements. The range complex also serves as critical support for Navy operational readiness training and for RDT&E of emerging maritime and combat technologies (DON, 2009h).

The JAX Range Complex geographically encompasses offshore, near-shore, and onshore OPAREAs, ranges, and special use airspace (SUA) located along the eastern coasts of South Carolina, Georgia, and Florida, extending eastward to 77 degrees west (°W) longitude. The JAX Range Complex, which covers both the Charleston and JAX OPAREAs, is a set of operating and maneuver areas with defined ocean surface and subsurface areas. The surface water area of the range complex covers the coast of South Carolina, Georgia, and Florida, encompassing 172,023 km² (50,090 NM²). The shoreward extent of the range complex is roughly aligned with the 5.6 km (3 NM) state territorial limits.

NSB Kings Bay, Georgia, is located in coastal southeastern Georgia, along the western shore of Cumberland Sound approximately 3 km (2 mi) north of St. Mary’s, Georgia and approximately 56 km (35 mi) north of Jacksonville, Florida. The site was designated as NSB Kings Bay in 1982, and encompasses approximately 65 km² (25 mi²). Facilities at the base enable Kings Bay to serve as a homeport, refit site, and training facility for the Navy personnel who operate and maintain the Ohio-class strategic submarines. The Navy Strategic Systems Programs proposed to construct and maintain security facilities to support continuous security service and incident response at NSB Kings Bay. Security improvements include a Waterfront Security Force.
Facility, an Auxiliary Reaction Force Facility, an Armored Fighting Vehicle Operational Storage Facility (AFVOSF); an Armory; road improvements to ensure efficient access to and from the proposed facilities; and construction of a new parking lot to replace lost parking spaces. No significant effects to environmental resources were expected.

NS Mayport is located near the Port of Jacksonville on the St. Johns River in northeast Florida. NS Mayport is home to 55 tenant commands and private organizations. Some two dozen ships are berthed in the Mayport basin, including Airborne Early Warning/Ground Environment Integration Segment (AEGIS) guided-missile cruisers, destroyers, guided-missile frigates, and aircraft carriers. NS Mayport covers 14 km² (5 mi²) and is the third largest naval facility in the continental United States. NS Mayport is unique in that it is home to a busy seaport as well as an air facility that conducts more than 135,000 flight operations each year. Training operations in the JAX Range Complex can vary from unit level exercises to integrated major range training events. A description of non-ASW training operations typically conducted in the JAX Range Complex can be found in Table 4.8-4 (DoN, 2008i).

The Navy proposes to increase and modify training and RDT&E operations from current levels in support of the FRTP, accommodate mission requirements associated with force structure changes, including those resulting from the introduction of new platforms (aircraft and weapons systems), and implement enhanced range complex capabilities in the JAX Range Complex. The purpose for the Navy’s proposed action in the JAX Range Complex is to:

- Achieve and maintain Fleet readiness using the JAX Range Complex to support and conduct current, emerging, and future training operations and RDT&E operations;
- Expand warfare missions supported by the JAX Range Complex; and
- Upgrade and modernize existing range capabilities to enhance and sustain Navy training and RDT&E.

The Navy released the Final EIS/OEIS for the JAX Range Complex to assess the potential environmental effects in the range complex over a 10-year planning horizon. (The JAX Range Complex Final EIS/OEIS is incorporated in this Final OEIS/EIS by reference and is available from the following Web site: http://www.jacksonvillerangecomplexoeis.com/.) The EIS/OEIS compared three alternatives: two alternatives involving changes to the training schedule, and the No Action Alternative (implementation of which would continue current operations, including surge capabilities, consistent with the FRTP). The Navy’s preferred alternative was identified as Alternative 2: Increases and Modifications in Operational Training, Accommodate Force Structure Changes, and Implement Enhancements Mine Warfare Training Capability. The Navy’s preferred alternative is considered representative of its future actions within the JAX Range Complex (DoN, 2009h).
### Table 4.8-4

<table>
<thead>
<tr>
<th>Range Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mine Warfare (MIW)</strong></td>
<td></td>
</tr>
<tr>
<td>Mine Laying</td>
<td>Airborne mine-laying training uses two types of training operations: Mine Exercises (MINEX) and Mine Readiness Certification Inspections. In the typical mining training profile, MINEXs usually involve a single aircraft sortie planting several inert training mine shapes in the water. The aircrew drops a series of (usually four) inert training shapes in the water.</td>
</tr>
<tr>
<td>Mine countermeasures</td>
<td>Mine Countermeasure (MCM) exercises train forces to detect, identify, classify, mark, avoid, and disable (or verify destruction of) sea mines using a variety of methods, including, air, surface, and subsurface assets.</td>
</tr>
<tr>
<td>Mine neutralization</td>
<td>Mine Neutralization operations involve the detection, identification, evaluation, rendering safe, and disposal of underwater unexploded ordnance that constitute a threat to ships or personnel.</td>
</tr>
<tr>
<td><strong>Surface Warfare (SUW)</strong></td>
<td></td>
</tr>
<tr>
<td>MISSILEX (A-S)</td>
<td>MISSILEX (A-S) (Live Fire) trains aircraft and helicopter crews in the delivery of optical, infrared seeking, or laser guided missiles (Hellfire and Maverick) at surface targets.</td>
</tr>
<tr>
<td>GUNEX (A-S)</td>
<td>GUNEX (A-S) trains aircraft and helicopter crews to attack surface targets at sea using guns.</td>
</tr>
<tr>
<td>GUNEX (S-S)</td>
<td>GUNEX (S-S) trains ship gun crews by firing against surface targets at sea.</td>
</tr>
<tr>
<td>BOMBEX (sea)</td>
<td>BOMBEX (sea) allows aircrew to train in the delivery of bombs against maritime targets.</td>
</tr>
<tr>
<td>Laser targeting</td>
<td>MISSILEX (A-S) (Laser Only) trains aircraft or helicopter crews in the delivery of optical, infrared seeking or laser guided missiles at surface targets. This operation does not result in live missile fire, only discrimination of the target and illumination of the target with a laser.</td>
</tr>
<tr>
<td><strong>Visit, Board, Search, and Seizure/Maritime Interdiction Operations (VBSS/MIO)-Ship</strong></td>
<td>Non-firing ULT and major exercise events. Each ship must conduct one VBSS/MIO every six months. Target vessel is typically another strike group ship or Mobile Sea Range (MSR) vessel such as Prevail.</td>
</tr>
<tr>
<td><strong>VBSS/MIO-Helicopter</strong></td>
<td>Non-firing ULT &amp; major exercise events. NSW personnel fast-rope onto target vessel from 1st helicopter. 2nd helicopter flies close cover, and 3rd helicopter flies surveillance.</td>
</tr>
<tr>
<td>GUNEX (S-S) (Fast Attack Craft/Fast Inshore Attack Craft [FAC/FIAC])</td>
<td>Non-firing major exercise event only. Typically involves multiple ships prosecuting multiple targets (High Speed Maneuverable Seaborne Targets or other small craft) during a choke point transit event.</td>
</tr>
<tr>
<td><strong>Air Warfare (AW)</strong></td>
<td></td>
</tr>
<tr>
<td>ACM</td>
<td>ACM is the general term used to describe an air-to-air (A-A) event involving two or more aircraft, each engaged in continuous proactive and reactive changes in aircraft attitude, and airspeed. No live weapons are fired during ACM operations.</td>
</tr>
<tr>
<td>Air Intercept Control</td>
<td>Surface ships and fixed wing aircraft train in using their search radar capability to direct strike fighter aircraft toward threat aircraft.</td>
</tr>
<tr>
<td>ACM Chaff Exercise</td>
<td>Chaff exercises train shipboard personnel and helicopter crews in the use of chaff to counter missile threats. Training and testing events not necessarily dedicated events, but combined with other exercises.</td>
</tr>
</tbody>
</table>
### Air Warfare (AW) Cont’d

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACM Flare Exercise</td>
<td>Trains aircraft personnel in the use of flares for defensive purposes when countering heat-seeking missile threats. Training and testing events not necessarily dedicated sorties, but may be combined with other exercises.</td>
</tr>
<tr>
<td>MISSILEX (A-A)</td>
<td>MISSILEX (A-A) are training operations in which air-to-air AIM missiles are fired from aircraft (live and non-explosive) against unmanned aerial target drones such as BWM-34 and BQM-74.</td>
</tr>
<tr>
<td>GUNEX (Air-to-Air)</td>
<td>GUNEX Air-to-Air training operations in which guns are fired from aircraft against towed aerial target banner.</td>
</tr>
<tr>
<td>GUNEX (S-A)</td>
<td>GUNEXs (S-A) are conducted by surface ships with 5-inch, 76mm and 20mm Close In Weapons Systems. Targets include unmanned drone as well as targets towed behind aircraft.</td>
</tr>
</tbody>
</table>

**Detect-to-Engage**

Shipboard personnel use all shipboard sensors (search and fire control radars and Electronic Support Measures (ESM)) in the entire process of detecting, classifying, and tracking enemy aircraft and/or missiles up to the of engagement, with the goal of destroying the threat before it can damage the ship.

### Strike Warfare (STW)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>FIREX with Integrated Maritime Portable Acoustic Scouring and Simulator System (IMPASS)</td>
<td>Surface-to-surface gunnery exercises with IMPASS are training operations that direct naval gunfire to strike land targets and support military operations ashore. This training is conducted at-se using a computer-simulated land target and a series of buoys that can acoustically score the training event.</td>
</tr>
<tr>
<td>BOMBEX (A-G)</td>
<td>BOMBEXs (Land) allow aircrews to train in the delivery of bombs against ground targets at Rodman Range.</td>
</tr>
<tr>
<td>Combat Search and Rescue (CSAR) and Convoy Operations</td>
<td>CSAR operations train rescue forces personnel the tasks needed to be performed to affect the recovery of distressed personnel during war or military operations other than war. Training takes place at Rodman Range.</td>
</tr>
</tbody>
</table>

### Electronic Combat (EC)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC Operations</td>
<td>Air or ship crews attempt to control critical portions of the electronic spectrum used by threat radars, communications equipment, and electronic detection equipment to degrade or deny enemy attacks.</td>
</tr>
<tr>
<td>Chaff Exercise</td>
<td>Exercises train aircrews the use of chaff to counter enemy threats by creating radar reflective false targets. Chaff may also be used offensively by aircrews or shipcrews to hide inbound striking aircraft or ships.</td>
</tr>
<tr>
<td>Flare Exercise (Aircraft Self-Defense)</td>
<td>Fixed-wing aircraft and helicopters deploy flares to disrupt threat infrared missile guidance systems to defend against an attack.</td>
</tr>
</tbody>
</table>

### Other Training

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipboard Electronic Systems Evaluation Facility Utilization (SESEF)</td>
<td>SESEF operations test ship antenna radiation pattern measurements and communications systems.</td>
</tr>
</tbody>
</table>

### Other Training

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Arms Training with anti-swimmer grenades</td>
<td>Training with anti-swimmer grenades (MK3A2, 8 oz HE). Not all events use explosive rounds in the exercise.</td>
</tr>
</tbody>
</table>
The preferred alternative purpose is to: achieve and maintain Fleet readiness using the JAX Range Complex to support and conduct current, emerging, and future training operations and RDT&E operations; expand warfare missions supported by the JAX Range Complex; and upgrade and modernize existing range capabilities to enhance and sustain Navy training and RDT&E. Also, the proposed action is needed to provide range capabilities for training and equipping combat-capable naval forces ready to deploy worldwide (DON, 2009h). The preferred alternative would increase operational training, expand warfare missions, accommodate force structure changes (including changing weapon systems and platforms and homebasing new aircraft and ships), and implementing enhancements, to the minimal extent possible to meet the components of the proposed action. This alternative is composed of all currently conducted operations including the introduction of the new MH-60 helicopter and new organic mine countermeasure systems. Additional mine warfare training capabilities and implementation of additional enhancements to enable the range complex to meet future requirements can also be expected of this alternative (DoN, 2009h).

With the preferred alternative, the Navy expects to eliminate live BOMBEX and designate MIW Training Areas in the JAX and Charleston OPAREA for enhanced mine countermeasures and neutralization training during major exercises (DoN, 2009h). Mine detection sonar would be used, use of this sonar is described within the AFAST Final EIS/OEIS (DoN, 2008h).

Physical, biological, environmental, cultural, socioeconomic, and human resources were analyzed to determine the potential effects any expended materials would cause. It was determined that there would be no significant impact and no significant harm to physical, biological, environmental, cultural, socioeconomic or human resources due to the training activities occurring in the JAX Range Complex (DoN, 2009h).

As a result of early discussions with the NMFS, it was determined that the agency was most concerned with potential impacts of military operations to sensitive habitats such as live/hard bottom, the proposed deepwater coral HAPC, and the recently established deepwater snapper-grouper marine protected areas. As part of the JAX Range Complex EIS/OEIS, the Navy determined that based on the distribution of these sensitive habitats, it is expected that some non-explosive practice bombs, missiles, and naval gun shells, as well as expended materials, would strike in these areas. The potential for strikes to adversely affect benthic communities in these areas would depend on the substrate and community types found at the point of physical impact. Given the dispersed nature of the training activities, often patchy distribution of community types, and relatively limited bottom mapping data, it was not possible to accurately determine the number of non-explosive practice bombs, missiles, and naval gun shells that would strike soft bottom habitats versus more sensitive areas such as live/hard bottom or coral mounds. Nonetheless, the total area of benthic habitat affected by non-explosive practice bomb, missile, and naval gun shell was determined to be small (about 881 m² [9,482 ft²] per year), and only a percentage (less than 881 m² [9,482 ft²] per year) of the total area affected would be sensitive benthic habitat such as live/hard bottom or coral mounds. Based on geographic data obtained through SAFMC, the study area contains about 64,890 km² (18,919 NM²) of live/hard bottom EFH. Assuming a worst-case scenario where all of the NEPMs were to settle in areas of live/hard
bottom, the total benthic habitat affected represents less than 0.000001 percent of the total live/hard bottom EFH in the study area. In addition, the probability of this event occurring was calculated to be approximately $6.13 \times 10^{-146}$. As a result, it was concluded that non-explosive practice bomb, missile, and naval gun shell strikes could result in long-term, minor effects to benthic EFH, but the effects would be localized and no long-term changes to community structure or function would be expected. Impacts to benthic EFH would be minimal based on the relatively small area affected by non-explosive practice bombs, missile, and naval gun shell. Given the small area affected, NEPM use under any of the alternatives presented in the JAX Range Complex EIS/OEIS would not reduce the quality and/or quantity of EFH in the study area. However, in a February 17, 2009 letter to the Navy, NMFS issued EFH conservation recommendations based on NMFS' separate determination that the Navy's release of expended materials would adversely affect EFH.

The Navy and NMFS further discussed the NMFS concern and concluded: (1) NMFS and the Navy have a mutual interest in understanding the potentially affected environment and the impacts of current and proposed Navy activities; (2) the spatial extent of the impacts to live/hardbottom habitats cannot be determined at this time based on the best available information; and (3) it is not feasible to forecast exact locations where the expended materials will settle upon the seafloor. As a result of the concerns expressed by NMFS and the above conclusions reached by both agencies, NMFS and the Navy agreed to further collaborate to establish an approach for improving coordination on data collection efforts and sharing such data to the extent national security and other Navy restrictions allow. As data collection and other research results in new habitat data, the Navy will continue to reassess and incorporate such information into future environmental planning for the JAX Range Complex. This approach may include: (1) NMFS identifying specific, finite areas of known or potential deepwater habitats of concern; (2) the Navy providing the areas where current/proposed activity would result in high use of expended materials that could potentially disturb bottom habitats; and (3) NMFS and the Navy agree to further assess those areas in future environmental planning documents once areas of overlap are identified.

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles as a result of activities performed with the preferred alternative. Refer to Chapter 3 of the JAX Range Complex EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 94 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment [a reduction from 1,141, under the No Action Alternative]. Acoustic analysis also indicates that 2 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment [reduced from 32 under the No Action Alternative]. No marine mammal mortality is predicted [under either the Preferred or No Action Alternative]. The results also indicate 38 instances of potential non-injurious harassment [reduced from 446 under the No Action Alternative] of ESA-listed sea turtles. No injurious harassments are predicted [reduced from 9 under the No Action Alternative].
The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2009h). These exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and/or sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal and/or sea turtle species or populations.

In accordance with 50 CFR § 402.11, after reviewing the current status of the endangered North Atlantic right whale, humpback whale, sei whale, fin whale, blue whale, sperm whale, loggerhead sea turtle, Kemp’s ridley sea turtle, leatherback sea turtle, Atlantic green sea turtle, and hawksbill sea turtle, the environmental baseline for the JAX study area, the effects of the proposed action, and the cumulative effects, NMFS issued a Programmatic Biological Opinion on June 5, 2009 concluding that the Navy’s proposal to conduct testing and training activities in the JAX study area each year for a 5-year period beginning in June, 2009, are likely to adversely affect but are not likely to jeopardize the continued existence of these threatened and endangered species under NMFS’ jurisdiction. NMFS also concluded that the effects of the proposed action are not likely to result in the destruction or adverse modification of critical habitat that has been designated for endangered or threatened species in the action area. Consultation with NMFS was considered complete on June 5, 2009 when NMFS issued both the Programmatic Biological Opinion and an Annual Biological Opinion for the period from June 2009 to June 2010.

In accordance with regulations under Section 7 of the ESA (50 CFR Part 402), the Navy requested informal consultation with USFWS on May 12, 2008 for the potential effects of the proposed action on Bermuda petrel, Florida scrub-jay, red-cockaded woodpecker, roseate tern, wood stork, West Indian manatee (including designated critical habitat), American alligator, eastern indigo snake, sand skink, pondberry, clasping warea, Lewton’s polygala, and scrub buckwheat. In a letter dated October 7, 2008, the USFWS concurred with the Navy’s determination that the preferred alternative will have no effect on, or is not likely to adversely affect the federally-listed species or designated critical habitat.

NMFS issued final regulations and an LOA on June 5, 2009 in accordance with the MMPA to authorize the incidental take of marine mammals that may result from the implementation of the activities analyzed in the JAX Final EIS/OEIS.

**Homeporting of Additional Surface Ships at Naval Station Mayport, Florida**

A Record of Decision was published in the Federal Register (FR) on January 21, 2009 (FR, Vol. 74, No. 12) in which the Navy, after carefully weighing the strategic, operational, and environmental consequences of the proposed action, announced its decision to homeport one nuclear-powered aircraft carrier (CVN) at Naval Station (NS) Mayport. The decision initiated a multi-year process for developing operational, maintenance, and support facilities at NS Mayport to support homeporting of one CVN. The multi-year process includes implementing projects for dredging and dredged material disposal, construction of CVN nuclear propulsion plant maintenance facilities, wharf improvements, transportation improvements, and construction of a
parking structure to replace existing parking that would be displaced by development of the CVN nuclear propulsion plant maintenance facilities.

The projects necessary to create the capacity to support CVN homeporting could be completed as early as 2014. No CVN homeport change will occur before operational, maintenance, and support facility projects are completed. The DON environmental analysis included extensive studies regarding impacts associated with dredging, facility construction, and homeport operations. This included determining potential environmental effects to earth resources, land and offshore use, water resources, air quality, noise, biological resources, cultural resources, traffic, socioeconomics, general services, utilities, and environmental health and safety were analyzed. Of those, potential environmental effects to biological resources are relevant to this EIS/OEIS. Additional information about this project can be obtained from the following Web site: http://www.mayporthomeportingeis.com/EISDocuments.aspx.

The environmental analysis undertaken by the DON included lengthy and detailed consultations with regulatory agencies, such as the U.S. Fish and Wildlife Service and the National Marine Fisheries Services, regarding impacts to endangered and threatened species, and the U.S. Army Corps of Engineers and the Environmental Protection Agency regarding dredging operations and the in-water disposal of dredged materials.

In accordance with section 7 of the Endangered Species Act (ESA), the DON consulted with the USFWS and NMFS regarding potential impacts to federally listed species and designated critical habitat for proposed construction and dredging activities.

With implementation of the conditions of the USFWS Letter of Concurrence, it was determined implementation of the dredge project would have no effect on nesting listed sea turtles; may affect, but is not likely to adversely affect Florida manatee; and would not destroy or adversely modify Florida manatee designated critical habitat.

With implementation of the conditions of the NMFS Biological Opinion (BO) dated 7 January 2009, it was determined implementation of the dredge project may affect, but is not likely to adversely affect shortnose sturgeon, smalltooth sawfish, North Atlantic right whales (NARW), and humpback whales. As NMFS determined in the BO, there is currently no NARW critical habitat in the proposed action area. NMFS also found, with implementation of the reasonable and prudent measures and the terms and conditions, dredging to include bed-leveling activities, is likely to adversely affect, but is not likely to jeopardize the continued existence of sea turtles (loggerhead, green, and Kemp’s ridley). Based on historical distribution data, hopper dredge observer reports, and observations of past strandings, loggerhead, green, and Kemp’s ridley sea turtles may occur in the action area and may be taken by the hopper dredging operations of this project. NMFS believes that the proposed action can be expected to lethally take up to 17 loggerhead, 3 green, and 2 Kemp’s ridley sea turtles during the proposed project.

For construction related to the Wharf F improvements, no anticipated impacts are expected to listed fish, sea turtles, and marine mammals. However, to further reduce any potential impacts,
the use of a vibratory hammer will be implemented for pile driving operations. If a marine mammal is observed within 50 ft of the proposed pile driving operations, operations would cease if practicable until the animal leaves the area.

**Mesa Verde Ship Shock Trial**

A Record of Decision was published in the Federal Register (FR) on July 28, 2008 (FR, Vol. 73, No. 145) in which the Navy announced its decision to conduct a shock trial for USS Mesa Verde in the area of the Atlantic Ocean offshore of Naval Station Mayport, Jacksonville, Florida during the summer (June 21 – September 20, 2008). The Final EIS considered all components of the physical, biological, and socioeconomic environment and concluded that potential impacts from execution of the shock trials would be less at the Mayport, Florida alternative site than at the alternative sites of Norfolk, Virginia or Pensacola, Florida.

The NMFS determined that the incidental taking of marine mammals resulting from conducting a Full Ship Shock Trial on USS Mesa Verde in the waters offshore of Mayport, Florida during the summer months would have a negligible impact on the affected marine mammal species or stocks. The Final Rule was published in the FR on July 24, 2008 (FR, Vol. 73, No. 143). The FR notice provides a list of mitigations and requirements for monitoring and reporting before, during, and after the trials are conducted. Additional information about this project can be found at the following Web site: [http://www.mesaverdeeis.com/documents.htm](http://www.mesaverdeeis.com/documents.htm).

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles. Refer to Chapter 4 of the Mesa Verde Ship Shock Trial EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 489 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment. Acoustic analysis also indicates that 8 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment. The analysis also indicates that the effect to 1 marine mammal mortality may also result. The results of the acoustic analysis indicate that no ESA-listed marine mammal species will be exposed or injured due to the training activities. The results also indicate the quantity of ESA-listed sea turtles that may be exposed to levels of sound, 2,079 species may result in Level B harassment, 46 may result in Level A harassment, and 1 may result in mortality. The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The Navy finds that ESA-listed species may experience a cumulative impact from AFAST active sonar activities; however, they are not expected to adversely affect the populations of ESA-listed species (DoN, 2008c; 2009g).)

The first shot of Mesa Verde’s shock trial was successfully conducted August 16, 2008. The second shot was successfully completed on August 26, 2008 and the third and final shock trial event was completed September 13, 2008 (DoN, 2009g). As detailed in the After-Action Mitigation Report for the Shock Trial of USS Mesa Verde submitted to the Director of NMFS’ Office of Protected Resources, the NMFS’ Southeast Region, and the Chief of NMFS’
Endangered Species Division - Office of Protected Resources, the mitigation component of the shock trial was successful. No mortalities or injuries to marine mammals or sea turtles were detected during the shock trial events or during post-mitigation monitoring. In addition, no marine mammal or sea turtle stranding has been attributed to the shock trial.

**Atlantic Fleet Active Sonar Training (AFAST) Utilizing Mid- and High-Frequency Active Sonar**

The Navy released the AFAST Final EIS/OEIS on December 12, 2008 (DoN, 2008h), evaluating the potential environmental effects associated with the use of mid- and high-frequency active sonar technology and the improved extended echo ranging (IEER) system during Atlantic Fleet Active Sonar Training (AFAST) activities within and adjacent to existing Navy operating Areas (OPAREAs) located along the East Coast of the United States and in the Gulf of Mexico. The Record of Decision (ROD) for AFAST was issued January 23, 2009. Navy OPAREAS include designated ocean areas near fleet concentration areas (i.e., homports). OPAREAS are where the majority of routine Navy training and research, development, test, and evaluation (RDT&E) activities occur. However, Navy training exercises are not confined to the OPAREAs. Some training exercises or portions of exercises are conducted seaward of the OPAREAs and a limited amount of active sonar use is conducted in water areas shoreward of the OPAREAs. The AFAST Final EIS/OEIS is incorporated in this Final OEIS/EIS by reference and additional information about this project can be obtained from the following Web site: [http://afasteis.gcsaic.com/docs.aspx](http://afasteis.gcsaic.com/docs.aspx).

In the ROD, the Navy announced its decision to designate areas where mid- and high-frequency active sonar and the IEER system training, maintenance, and RDT&E activities will occur, and to conduct these activities. AFAST training and RDT&E activities involving active sonar and the IEER system are collectively described as active sonar activities. These active sonar activities are not new and do not involve significant changes in systems, tempo, or intensity from past activities. The purpose of the Proposed Action is to provide active sonar training for U.S. Navy Atlantic Fleet ship, submarine, and aircraft crews, and to conduct RDT&E activities to support the requirements of the Fleet Readiness Training Plan (FRTP) and stay proficient in Anti-Submarine Ware (ASW) and Mine Warfare (MIW) skills. The FRTP is the Navy’s training cycle that requires naval forces to build up in preparation for operational deployment and to maintain a high level of proficiency and readiness while deployed.

The AFAST Final EIS/OEIS evaluates the potential environmental impacts of four alternatives. The No Action Alternative is the Navy’s preferred alternative. Under the No Action Alternative the Navy would continue conducting active sonar activities within and adjacent to existing OPAREAs rather than designate active sonar areas or areas of increased awareness.

The Navy analyzed potential impacts on multiple resources including, but not limited to, the marine environment, marine life, and socioeconomic resources. No significant adverse impacts are identified for any resource area in any geographic location within the AFAST study area that cannot be mitigated, with the exception of exposure of marine mammals and sea turtles to underwater sound. Potential unavoidable adverse effects that cannot be mitigated resulting from
implementation of the proposed action would be limited to exposure of marine mammals (endangered and threatened, and non-endangered and threatened) to underwater sound associated with mid- and high-frequency active sonar and explosive source sonobuoys (AN/SSQ-110A). In addition, endangered sea turtles may be exposed to underwater sound from explosive source sonobuoys.

Acoustic analysis was performed to determine potential effects to marine mammals and sea turtles as a result of activities performed with the preferred alternative. Refer to Chapter 3 of the AFAST EIS/OEIS for a discussion of the methodology used to measure these effects. Acoustic analysis indicates that 1,911,198 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level B harassment under the preferred alternative. Acoustic analysis also indicates that 128 total marine mammals (including ESA-listed species) may be exposed to levels of sound likely to result in Level A harassment. No marine mammal mortality is predicted. The results also indicate 5 instances of potential Level B harassment and 1 instance of Level A harassment of ESA-listed sea turtles.

The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year (DoN, 2008h). These exposure estimates do not include the incorporation of mitigation measures, which are designed to reduce exposure of marine mammals and/or sea turtles to potential impacts in an effort to achieve the least practicable adverse effect on marine mammal and/or sea turtle species or populations.

NMFS issued a BO (NMFS, 2009j) on the Navy’s proposal to conduct active sonar training activities along the East Coast of the U.S. and in the Gulf of Mexico. The BO concludes that the Navy’s proposal to conduct major training exercises, unit-level and intermediate-level training activities, and RDT&E activities each year for a 12-month period beginning in January 2009 are likely to adversely affect, but are not likely to jeopardize the continued existence of threatened and endangered marine mammal and turtle species under NMFS jurisdiction. The BO also concludes that the active sonar training activities are not likely to result in the destruction or adverse modification of critical habitat that has been designated for endangered or threatened species in the action area. However, NMFS anticipates incidental takes of threatened and endangered species under its jurisdiction and has issued an ITS pursuant to Section 7 of the ESA. This ITS contains reasonable and prudent measures with implementing terms and conditions to help minimize takes.

NMFS issued an LOA on January 22, 2009 in accordance with the Marine Mammal Protection Act (MMPA) to authorize the incidental take of marine mammals that may result from the implementation of the activities analyzed in the AFAST Final EIS/OEIS.

**Military Operations – Atlantic Ocean, Offshore of the Northeastern United States**

The Northeast OPAREAs are located in the western Atlantic Ocean off the Northeast Coast of the United States and the Southeast Coast of Canada and are made up of the Boston OPAREA,
Narragansett OPAREA, and Atlantic City OPAREA. Lying adjacent to the Northeast OPAREAs are the states of Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine as well as the Canadian provinces of New Brunswick and Nova Scotia. Additional Navy special use areas within the Northeast OPAREAs include the COLE Special OPAREA, located in the Gulf of Maine, the Small Point Mining Range, just off the central Maine coast, and the CGULL OPAREA, located off the southern flank of Georges Bank. Submarine transit lanes are also located within the Boston and Narragansett Bay OPAREAs (DoN, 2005a). Activities in these areas include surface-to-air gunnery, anti-submarine warfare (ASW) tactics, and surface/subsurface operations (GlobalSecurity, 2007d).

4.8.5 Reasonably Foreseeable Future Actions Relevant to the Proposed Action

4.8.5.1 Military Operations

4.8.5.1.1 Navy Training That Does Not Utilize Active Sonar

The Navy has historically conducted Atlantic Fleet training operations other than those utilizing active sonar in the same range complexes along the east coast and the Gulf of Mexico as described in this DOEIS/EIS. The range complexes consist of inland ranges and targets, airspace, and at-sea surface and subsurface space. U.S. Atlantic Fleet is currently preparing environmental planning documents that will assess the potential for environmental effects associated with current and future non-active sonar training activities and actions, and RDT&E events, which are conducted within several range complexes.

The following Navy Range Complex environmental documents are currently in progress:

**An Environmental Assessment/Oversees Environmental Assessment (EA/OEA) for the Key West Range Complex off of the Southern Coast of Florida.**

The types of training and RDT&E events that make up the Proposed Action in the above range complex environmental documents include both current and future training and RDT&E, and proposed improvements to the range complexes. The majority of the training to be assessed represents on-going activities that have historically been conducted by the Navy on the East Coast and in the Gulf of Mexico. The types of training and RDT&E events that will be assessed include: air-to-surface bombing events on land ranges and at sea using explosive and non-explosive ordnance; gunnery events using explosive and non-explosive ordnance; mine hunting, identification, classification, and countermeasures events using various types of equipment; underwater detonations using explosive ordnance; missile firing events using explosive and non-explosive ordnance; maritime interdiction operations involving various types of craft; combat search and rescue events; aircraft flight and maneuver training using helicopters, fixed-wing aircraft, and unmanned aerial vehicles; amphibious landings; electronic combat training; and other various types of training using lasers, flares and evasive devices. Environmental resources that will be addressed in these documents include: the physical
environment; sea turtles and marine mammals; fish and EFH; seabirds and migratory birds; endangered and threatened species; land use; airspace; noise; air quality; geology; soils; water quality; geology; water resources and water quality; hazardous materials; cultural resources; socioeconomics; and safety.

**Proposed Dredging of the Norfolk Harbor Channel in Norfolk and Portsmouth, Virginia**

The Navy, in cooperation with the Army Corps of Engineers (USACE), has prepared a Draft Environmental Impact Statement (DEIS) to evaluate the environmental consequences of deepening approximately five miles of the Norfolk Harbor Federal Navigational Channel in the Southern Branch of the Elizabeth River, separating Norfolk and Portsmouth, Virginia. Dredging will extend from the Lamberts Point Deperming Station in the Lamberts Bend Reach south to the Norfolk Naval Shipyard (NNSY) in the Lower Reach. This channel is the only means of nuclear-class aircraft carrier (CVN) access to the Lamberts Bend Deperming Station and NNSY. The current average depth of the Norfolk harbor Channel from Lamberts Bend to the Lower Reach at NNSY is maintained by the USACE Norfolk District, varying in depth from approximately 40 to 43 feet below mean lower low water (-40 to -43 feet MLLW). The existing channel depths are not sufficient to allow safe, unrestricted access by CVNs to the Lamberts Bend Deperming Station and NNSY and to avoid incidents of fouling and clogging of the cooling systems of the CVNs. The Navy needs at least 6 feet of water between the aircraft carrier’s keel and the bottom of the river channel.. A Notice of Intent for the EIS was published in the Federal Register on September 19, 2006 (71 FR 54803) which also announced two public scoping meetings were held in October 2006 in Norfolk and Portsmouth, Virginia.

The Proposed action would occur solely within the Norfolk Harbor Channel’s existing limits and deepen the heavily used waterway at Lamberts Bend to -50 feet MLLW, plus three feet of overdredge for a new depth-in-channel of -53 feet MLLW. The remainder of the channel (Port Norfolk, Town Point, and Lower Reaches) would be deepened to -47 feet MLLW plus three feet of overdredge for a new depth-inchannel of -50 feet MLLW. Overdredge depth is typically needed to ensure project depths and allow a margin of accuracy. The proposed action would bring the Norfolk harbor Channel in compliance with the Naval Sea Systems Command (NAVSEA) water depth requirements for homeports and entrance channels to shipyards, providing CVNs with continuous safe and uninterrupted access to the Lamberts Point Deperming Station and NNSY.

The DEIS evaluates the potential environmental impacts of two action alternatives and the No Action Alternative. Alternative A (the preferred alternative) would implement the proposed dredge depths for aircraft carriers for homeports and entrance channels to shipyards. Alternative B would involve a combination of partial deepening of the Norfolk Harbor Channel and operational restrictions based on tidal activity. It would represent an improvement over the existing situation in that with partial deepening, there is less likelihood of sediment from the river bottom fouling ship systems. However, with only the partial deepening, the carrier movements would still need to wait for high tide conditions to provide the needed water depths.
below the keel of the carriers. Under both alternatives, dredged materials would meet USACE sediment quality thresholds for disposal at the Craney Island Dredged Materials Management Area (CIDMMA). Under the No Action Alternative, no deepening of the Norfolk harbor Channel would occur. The channel would continue to be available at the existing controlling dimensions and access to the deperming station and NNSY would remain restricted for use by carriers.

Dredging would be done either by hydraulic (pipeline) or mechanical (clam-shell/bucket) equipment. Hydraulic dredging uses a cutterhead to break up sediment on the river bottom and suction to transport the material through a flexible pipeline to the disposal site. For the mechanical system, the river bottom materials are scooped out, placed on a barge, and then transported to the disposal site. Under the preferred alternative, it is anticipated that approximately 4 million cubic yards of dredged material would be removed. This would be equivalent to about 1 foot of dredged material spread over 2,500 acres.

In addition, the DEIS addresses potential environmental impacts on multiple resources, including but not limited to: water resources, air quality, noise, biological resources, cultural resources, traffic, socioeconomic and environmental justice, general services, utilities and infrastructure, and environmental health and safety. With the exception of noise and aesthetics, no significant impacts are identified for any resource area.

The Navy performed several project specific surveys to understand existing conditions in the Elizabeth River and to assess the potential impacts of dredging on water quality and marine life. The surveys were also important for determining disposal options for the sediments to be dredged. Sediment samples were taken from three different depths at 30 separate locations within the channel area. These 90 samples were collected and analyzed for physical and chemical properties per a plan developed with the Virginia Department of Environmental Quality (VADEQ), the Virginia Marine Resources Commission and the Corps. Follow-up sediment testing was also done in the Lower Reach by the Corps to determine acceptability of dredged material for Craney Island disposal. Clay is the primary sediment type of project area, followed by sand and silt. Evidence of chemical compounds were detected in some of the sediment samples, with the majority of these potential pollutants occurring in the upper layer of river sediment. These channel sediments would be removed by the deepening with Alternatives A or B. Federal and state permits are required and will be obtained before dredging and disposal will occur. After review of sediment sampling and testing results, the Corps-Norfolk District has indicated that the dredged material would be acceptable for placement at Craney Island.

As for water quality, short term impact with the channel from suspended sediment (turbidity) during dredging are predicted for Alternatives A and B. Mixed sediment and water samples, called elutriate, were tested for 122 chemical parameters to determine the potential for contaminants to be released to the water after dredging or to travel via water discharge after dredged material is placed at Craney Island. Results were compared to VADEQ surface water quality standards and were found to be within standards for the protection of human health and the environment. Also, hydrodynamic modeling was conducted by the Virginia Institute of
Marine Science (VIMS) under contract with the Navy to study the potential impacts of dredging on elevation, salinity, current speed, sedimentation potential) of the Elizabeth River. VIMS used a computer model to predict long and short term effects. The model predicted the following minor long term changes: (a) Surface elevation: 0.2%; (b) Surface and Bottom Currents: less than 10%; (c) Surface and Bottom Salinity: average 0.03 parts per thousand (ppt) with maximum of 0.16 ppt or less than 1% of the existing 15 ppt to 25 ppt of the Elizabeth River; and, (d) Sedimentation: 0.5% to 2% increase during low flow conditions.

Potential impacts to biological resources (benthic habitat and marine and terrestrial species) were also analyzed with the following conclusions. Macrobenthic surveys of the river bottom were conducted by specialists at Old Dominion University in Norfolk under contract with the Navy. Grab samples of the upper layer of sediment at 25 locations were collected in the proposed dredging area. The analysis documented the presence and diversity of organisms living on the river bottom. The macrobenthic communities of Norfolk Harbor Channel rated degraded or severely degraded on the Benthic Index of Biotic Integrity, which indicates the quality of the river bottom environment, as compared with all locations within Chesapeake Bay. There would be short term impacts to river organisms from dredging activities with Alternatives A and B, including the direct removal of benthic species. However, benthic communities would recolonize, and the removal of the degraded sediment would result in improved habitat quality for benthic species. Degraded sediments would not be removed with the No Action Alternative.

An Essential Fish Habitat (EFH) assessment was prepared, as required by the Magnuson-Stevens Fishery Conservation and Management Act, and included in the DEIS. The proposed dredging project would result in local, temporary impacts to designated EFH, other managed fisheries resources, and prey organisms of EFH species. However, based on the expected short term nature of the direct impacts, minimal changes to aquatic habitat, and the generally degraded quality of the existing marine environment, these impacts are not considered to be significant.

Federal and state regulatory agencies were contacted about the potential for threatened or endangered species or other special-status species to be present within the area affected by the proposed action alternatives. There were no recent records of any federally listed species occurring in the proposed project area nor was any portion of the area classified as critical habitat for those species. The CIDMMA provides nesting and foraging habitat for 270 species of birds, many of them migratory species. The continuing rotational use of the disposal containment cells and habitat management measures undertaken by the Corps at the Craney Island disposal area would prevent the “taking” (i.e., killing or transporting) of migratory birds or their eggs, which is prohibited under the Migratory Bird Treaty Act.

There would be no reasonably foreseeable takes of marine mammals as defined by the MMPA, as these species are not likely to occur within the area affected. In the unlikely event bottlenose dolphin (the only mammal that may occur near the project area) move into the area during dredging, they are highly mobile and would likely leave the area.
Potentially significant noise impacts may occur at one receptor (Town Point Park), depending on the actual dredge equipment to be used. The Navy’s policy is to comply with local noise ordinances to the maximum extent practicable, therefore mitigation or minimization measures may be implemented, if needed, at Town Point Park. There is also a potential for cumulative visual impacts from implementation of the proposed action due to the need for the USACE to increase the height of dikes surrounding the containment cells at CISMMMA to maintain capacity.

The Notice of Availability of the DEIS for public comment was published in the Federal Register (74 FR 3034) on January 16, 2009, and the period for receiving comments closed on March 2, 2009. Also, an announcement was published in the Federal Register (74 FR 4145) concerning the public information meeting which was held on February 11, 2009, in Portsmouth, Virginia, where Navy representatives were available to explain the proposal, answer questions, and receive comments from the public. The DEIS is incorporated by reference and is available for electronic public viewing at http://www.NorfolkdredgingEIS.com.

Atlantic Ocean, Offshore of the Northeastern United States

The need for inert bombing training in W-102 East by P-3s will cease after 2009 due to the 2005 BRAC decision to consolidate East Coast P-3 squadrons at NAS Jacksonville (DoN, 2008j).

4.8.5.1.2 Navy Training Utilizing Active Sonar

Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

The Final Supplemental Environmental Impact Statement (Final SEIS) for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar was issued in April 2007(DoN, 2007k), and the Record of Decision (ROD) was issued in August 2007 (DoN, 2007k). Under the action, a maximum of four systems would be deployed in the Pacific-Indian ocean area and in the Atlantic-Mediterranean area. Of an estimated maximum 294 underway days per year, the SURTASS LFA sonar would be operated in the active mode about 240 days. During these 240 days, active transmissions would occur for a maximum of 432 hours per year per vessel. The duty cycle of the SURTASS LFA sonar would be limited (it would generally be on between 7.5 and 20 percent of the time [7.5 percent is based on historical LFA operations since 2003 and the physical maximum limit is 20 percent]). The LFA transmitters would be off the remaining 80 to 92.5 percent of the time (DoN, 2007k). The decision, as stated in the ROD, implemented Alternative 2 as the preferred alternative (NMFS, 2007o). Additional information about this project can be found at the following Web site: http://www.surtass-lfa-eis.com/.

Under Alternative 2, the SURTASS LFA sonar would be employed with geographical and seasonal restrictions to include maintaining sound pressure level below 180 dB within 22 km (12 NM) of any coastline and within the offshore biologically important areas that are outside of 22 km (12 NM). During the annual LOA process, the Navy will evaluate potential offshore biologically important areas within the proposed operating areas for each ship and incorporate restrictions, as required, into the LOA applications for NMFS’s review and action. LFA sound
fields will not exceed 145 dB within known recreational and commercial dive sites. Monitoring mitigation includes visual, passive acoustic, and active acoustic (high-frequency marine mammal monitoring [HF/M3] sonar) to prevent injury to marine animals when employing SURTASS LFA sonar by providing methods to detect these animals within the 180 dB LFA mitigation zone (DoN, 2007k).

The Final SEIS analyzed potential impacts to fish, sea turtles, marine mammals, and socioeconomics (commercial and recreational fishing, research and exploration activities, other recreational activities). Under Alternative 2, the potential impact on any stock of fish, sharks or sea turtles from injury was considered negligible, and the effect on the stock of any fish, sharks or sea turtles from significant change in a biologically important behavior was considered negligible to minimal. Any auditory masking in fish, sharks or sea turtles is expected to be of minimal significance and, if occurring, would be temporary (DoN, 2007k). The potential impact on any stock of marine mammals from injury is considered to be negligible, and the effect on the stock of any marine mammal from significant change in a biologically important behavior is considered to be minimal. Any momentary behavioral responses and possible indirect impacts to marine mammals due to potential impacts on prey species are considered not to be biologically significant effects. Any auditory masking in mysticetes, odontocetes, or pinnipeds is not expected to be severe and would be temporary (DoN, 2007k). Further, there will be no significant impact to socioeconomic resources.

NMFS issued the Final Rule: Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to the U.S. Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar in August 2007 (DoN, 2007h). NMFS has determined that the incidental taking of marine mammals resulting from SURTASS LFA sonar operations would have a negligible impact on the affected marine mammal species or stocks over the 5-year period of LFA sonar operations. That assessment is based on a number of factors:

- The best information available indicates that effects from SPLs less than 180 dB will be limited to short-term Level B behavioral harassment averaging less than 12 percent annually for all affected marine mammal species.

- The mitigation and monitoring is highly effective in preventing exposures of 180 dB or greater.

- The results of monitoring as described in the Navy’s Comprehensive Report supports the conclusion that takings will be limited to Level B harassment and not have more than a negligible impact on affected species or stocks of marine mammals.

- The small number of SURTASS LFA sonar systems (two systems in FY 2008 and FY 2009 (totaling 864 hours of operation annually), 3 in FY 2010 (totaling 1296 hours of operation annually), and 4 systems in FY 2011 and FY 2012 (totaling 1728 hours of operation annually) that would be operating world-wide.
That the LFA sonar vessel must be underway while transmitting (in order to keep the receiver array deployed), limiting the duration of exposure for marine mammals to those few minutes when the SURTASS LFA sonar sound energy is moving through that part of the water column inhabited by marine mammals.

In the case of convergence zone propagation, the characteristics of the acoustic sound path, which deflect the sound below the water depth inhabited by marine mammals for much of the sound propagation (see illustration 67 FR page 46715 [July 16, 2002]).

The findings of the Scientific Research Program on low-frequency sounds on marine mammals indicated no significant change in biologically important behavior from exposure to sound levels up to 155 dB.

During the 40 LFA sonar missions between 2002 and 2006, there were only three visual observations of marine mammals and only 71 detections by the HF/M3 sonar, which all resulted in mitigation protocol suspensions in operations. These measures all indicate that while marine mammals will potentially be affected by the SURTASS LFA sonar sounds, these impacts will be short-term behavioral effects and are not likely to adversely affect marine mammal species or stocks through effects on annual rates of reproduction or survival. In addition, mortality of marine mammals is not expected to occur as a result of LFA sonar operations (NMFS, 2007i).

4.8.5.2 MMS Regulated Activities: Alternative Energy Development (Offshore Wind, Wave, and Ocean Current Energy Capture)

United States Department of the Interior, Minerals Management Service (MMS), released a final programmatic EIS in support of the establishment of a program for authorizing alternative energy and alternate use (AEOU) activities on the Outer Continental Shelf (OCS), as authorized by Section 388 of the Energy Policy Act of 2005 (EPAct), and codified in subsection 8(p) of the Outer Continental Shelf Lands Act (OCSLA). The final programmatic EIS examines the potential environmental effects of the program on the OCS and identifies policies and best management practices that may be adopted for the program.

Offshore wind farms are being used in a number of countries to harness the energy of the moving air over the oceans and converting it to electricity. At present, the only wind farms worldwide are located off the coasts of Europe in waters 30 m (98 ft) deep or less. These wind farms currently harness just over 600 megawatts (MW) of offshore wind energy. However, offshore wind projects proposed worldwide through 2010 would produce more than 11,000 MW. Of these proposed projects, wind farm energy production in the United States would amount to roughly 500 MW (MMS, 2007e). With the passage of the Energy Policy Act of 2005, the MMS was given jurisdiction over offshore alternative energy projects, including wind farms (MMS, 2007d).
Construction and everyday operation of offshore wind farms has the potential to affect several environmental resources, especially biological resources. Potential effects might include bird collisions with rotors or towers, increases in underwater noise due to construction and operational vibrations, the creation of underwater electromagnetic fields, and sea floor alterations due to installation (MMS, 2007e).

4.8.5.2.1 MMS – Atlantic Ocean, Offshore of the Southeastern United States

A preliminary permit was issued by FERC to Ocean Renewable Power Company, on March 16, 2005, for the two SeaGen turbine projects: SeaGen Ft. Lauderdale, and SeaGen West Palm Beach. Based on further research into the technology, it was determined that the SeaGen turbines were not ready for commercial deployment. As such, the OCGen™ technology was developed, which was determined to be more appropriate. A preliminary permit for the Ft. Lauderdale and West Palm Beach sites was filed on March 13, 2008 (Ocean Renewable Power Company, 2008a, b). Both proposed projects would be located in the Gulf Stream Current and a cable would run to the shore. The proposed project coordinates for the Ft. Lauderdale proposed project site are as follows:

- 26° 05’ 53.18”N 79° 55’ 55.37”W
- 26° 04’ 08.56”N 79° 55’ 56.32”W
- 26° 05’ 51.41”N 79° 52’ 03.65”W
- 26° 04’ 06.8”N 79° 52’ 04.66”W

The proposed project coordinates for the West Palm Beach proposed project site are as follows:

- 26° 47’ 23.25” N 79° 51’ 55.89” W
- 26° 45’ 38.65” N 79° 51’ 56.93” W
- 26° 47’ 21.33” N 79° 48’ 02.8” W
- 26° 45’ 36.73” N 79° 48’ 03.9” W

The overall surface area of the two proposed permits in the area of turbine deployment is approximately 21 km² (6 NM²); however, both projects would be smaller in area (Ocean Renewable Power Company, 2008a, b).

On November 3, 2008, in response to FERC’s Notice of Preliminary Permit Application Accepted for Filing and Soliciting Comments, Motions to Intervene, and Competing Applications for each project, it was determined that FERC has no authority to permit or license ocean energy projects on the OCS; Since such permitting actions are regulated by the MMS, it was recommended that FERC deny issuance of preliminary permits (FERC, 2008). No further information regarding the issuance of these preliminary permits is available to date.
**4.8.5.2.2 MMS – Atlantic Ocean, Offshore of the Northeastern United States**

*Patriot Renewables, LLC-Proposed Buzzards Bay Wind Farm*

Patriot Renewables, LLC is studying the feasibility of siting the South Coast Offshore Wind project in Buzzards Bay, located in Massachusetts (Patriot Renewables, 2006). This proposed wind farm would lie approximately 1.6 to 4.8 km (1 to 3 mi) offshore and be comprised of 90 to 120 turbines spaced 804 to 402 m (0.5 to 0.25 mi) apart (Patriot Renewables, 2006). Due to its proposed location within state-regulated waters, this wind farm would be regulated by the State of Massachusetts, not the MMS.

*Cape Wind Offshore Wind Farm on Nantucket Sound*

Cape Wind Associates, LLC has proposed the establishment of a wind farm project in federal waters of Nantucket sound off Massachusetts. The wind farm would be located 8.05 km (5 mi) or more from shore and consist of 130 turbines over an area of 62.16 km² (24 mi²) (MMS, 2007d). The Cape Wind offshore wind farm would produce roughly over 1.4 million MW-hours per year, and save the area an estimated $800 million in energy costs over the next 20 years (Cape Wind, 2007a). A DEIS was released in 2004, predicting temporary, local impact to avian populations, benthos, water turbidity, and underwater sound levels during construction; and a potential long-term impact to avian populations (USACE, 2004). The FEIS for this project is currently being prepared (MMS, 2007d), and construction is expected to start in 2010 (Cape Wind, 2007b).

*Long Island Power Authority Offshore Wind Farm on Southside of Long Island Sound, New York*

Long Island Power Authority (LIPA) and Florida Power and Light Energy propose the development of the Long Island Offshore Wind Park project in federal waters about 5.8 km (3.6 mi) south of Jones Beach Island, Long Island, New York. This proposed wind farm would consist of 40 turbines covering 20.72 km² (8 mi²) (MMS, 2007f). The Long Island Offshore Wind Park would produce about 435,000 MW-hours per year, and would decrease the amount of fossil fuels required for energy production by an estimated $810 million over the course of 20 years (LIPA, 2007a, b).

**4.8.5.3 Maritime Traffic, Commerce, and Shipping Lanes**

**4.8.5.4.1 Proposed Marine Container Terminal at the Charleston Naval Complex**

There are five marine terminals in the Charleston Harbor area that are owned and operated by the South Carolina State Ports Authority (SCSPA). North Charleston Terminal, Columbus Street Terminal, and Wando Welch Terminal are primarily container terminals and Union Pier and Veterans terminals are dedicated break-bulk facilities (SCSPA, 2008). Combined, the terminals comprise over two million square feet of warehouse and storage space and can accommodate more than 17 vessels at a time (City of North Charleston, 2008). Channels leading to the terminals are deep and wide enough to handle 8,000 twenty-foot equivalent (TEU) ships. All terminals are located within two hours of the open sea (SCSPA, 2008).
In 2004, the Port of Charleston handled approximately 1.725 million 20-foot equivalent units (TEU) (USACE, 2004). The volume of containerized cargo is projected to increase 4.28 percent per year and will reach four million TEUs by the year 2025 (SCSPA, 2008; USACE, 2007c). To accommodate the increase in future demand for the number of containers that pass through the Port of Charleston each year, construction of a sixth terminal was permitted in 2007 (USACE, 2007c). This port facility will be located on the Cooper River approximately \((0.9 \text{ km}^2) (0.3 \text{ mi}^2)\) of land at the south end of the former Charleston Navy Base in North Charleston, South Carolina (USACE, 2007c).

It is estimated that the baseline vessel traffic on the Cooper River will increase from 1,365 trips per year in 2004 to 3,219 trips per year in 2025 (USACE, 2006). This equates to an increase from 3.7 trips per day in 2004 to 8.8 trips per day in 2025, or just over five trips per day over a 21-year period. The proposed facility is estimated to be operational in 2012 (USACE, 2006).

### 4.8.5.4.2 Port Access Route Study

The Coast Guard is conducting a Port Access Route Study (PARS) on the area east and south of Cape Cod, Massachusetts, to include the northern right whale critical habitat, mandatory ship reporting system area, and the Great South Channel including Georges Bank out to the exclusive economic zone (EEZ) boundary (Coast Guard, 2007). The purpose of the PARS is to analyze potential vessel routing measures that might help reduce ship strikes with the highly endangered North Atlantic right whale while minimizing any adverse effects on vessel operations. The recommendations of the study will inform the Coast Guard and may lead to appropriate international actions.

### 4.8.5.5 Marine Reserves

#### 4.8.5.5.1 Deepwater Coral Habitat Areas of Particular Concern

Deepwater areas off the southeastern coast of the U.S. have been proposed by the NMFS as deepwater coral habitat areas of particular concern (coral HAPCs) (SAFMC, 2004b). The current regulations for the proposed coral HAPCs are meant to preserve unique and fragile deepwater coral habitats critical to SAFMC-managed species of fish, particularly those in the snapper-grouper complex (SAFMC, 1998b). Recently, the NMFS proposed the following locations as coral HAPCs: Stetson Reef, Savannah and East Florida Lithoherms, and Miami Terrace. These locations occur in large areas of the Jacksonville and Charleston OPAREAs and in close proximity to Site A (Figure 4.8-2) and in the southeastern corner of Site B (Figure 4.8-3). The current regulations have not defined the restrictions in use that would apply to these areas. However, it is likely that the restrictions would be similar to those of the designated Oculina Bank HAPC, where the use of bottom longlines, bottom trawls, pots, entanglement gear, anchors, and grappling hooks are prohibited (SAFMC, 1998b; NMFS, 2000). The Navy has initiated coordination with the NMFS as to how to best avoid or minimize conflicts between the proposed USWTR ranges and the proposed coral HAPCs.
NS Mayport
NAS Jacksonville

Proposed Deepwater Coral HAPCs - Site A

Figure 4.8-2

Depth Contours

- 36.6 m (20 fm or 120 ft)
- 91.4 m (50 fm or 300 ft)
- 2000 m (1100 fm or 6600 ft)

Proposed Deepwater Coral HAPCs - Site B

Charleston AFB

Naval Weapons Station, Charleston

Charleston OPAREA

Jacksonville OPAREA

Depth Contours
- - - - - - - - - - - 36.6 m (20 fm or 120 ft)
- - - - - - - - - - - 91.4 m (50 fm or 300 ft)
- - - - - - - - - - - 2000 m (1100 fm or 6600 ft)


Figure 4.8-3
4.8.6 Summary of Impacts Relative to the Proposed Action

4.8.6.1 Assessing Individual Past, Present and Future

In this subchapter, past and present actions, as well as reasonably foreseeable future actions, have been identified. A value of “NE” through “***” was assigned to each action based on its potential to cause an adverse effect to a specific resource area. An example of each value is as follows:

- A “NE” value would be given to an action that has no adverse effects to a particular resource.
- A “*” would be given to an action that has the potential for minor, but recoverable, adverse effects to a particular resource. Examples include a negligible or less than significant effect to a resource.
- A “**” would be given to an action that has the potential for moderate, but recoverable, adverse effects to a particular resource. Examples include a measurable effect to a resource, but an effect that would be recoverable.
- A “***” would be given to an action that has the potential for major, non-recoverable, adverse effects to a particular resource. Examples include a significant effect to a resource, including effects that are not recoverable.

Table 4.8-5 shows, in tabular format, the environmental resources identified previously in this OEIS/EIS that could potentially be affected by the proposed action. The table also presents other past, present, and reasonably expected future actions potentially affecting the same resources, and the magnitude of each individual action.

4.8.6.2 Assessing Proposed Action Impacts

Ideally, the effects of all activities would be quantifiable and the cumulative results combined as appropriate. However, quantifiable data are available for only a portion of the activities. For example, commercial shipping, fishing, boating, and other activities are not required to comply with the NEPA; nor is analysis of the potential effects of these activities required. Therefore, there is little to no analysis data available of the potential effects associated with such activities. Since a quantitative analysis of potential effects for these areas is not possible; qualitative information, such as known marine species injuries or deaths was used as appropriate. In addition, since an analysis of potential environmental effects for future actions (identified in Subchapter 4.8.4) has not been completed, assumptions based on past actions were used.
### Table 4.8-5

Summary of Cumulative Impacts in the Study Area

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<tr>
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<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>MMS: Oil and Gas</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
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<tr>
<td>State Oil and Gas</td>
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<td>*</td>
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<td>*</td>
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<td>Dredging</td>
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<td>Commercial and Recreational Fishing</td>
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<td>NE</td>
<td>*</td>
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<td>**</td>
<td>NE</td>
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<tr>
<td>Environmental Contamination and Biotoxins</td>
<td>NA</td>
<td>NA</td>
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<td>NE</td>
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<td>**</td>
<td>**</td>
<td>**</td>
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<td>**</td>
<td>NE</td>
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<td>Future Actions</td>
<td>Military Operations</td>
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<td>NE</td>
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</tr>
<tr>
<td>Offshore Windfarms</td>
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<td>AFAST</td>
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<td>*</td>
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<td>NE</td>
<td>**</td>
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<td></td>
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<tr>
<td>USWTR Proposed Action</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>**</td>
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<td>*</td>
<td>NE</td>
<td>*</td>
<td>NE</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>Cumulative Impacts of All Actions</td>
<td>*</td>
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<td>*</td>
<td>*</td>
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<td>NE</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

**NE** = No adverse effects; **NA** = Not applicable; * = Potential for minor, but recoverable, adverse effects; ** = Potential for moderate, but recoverable, adverse effects; *** = Potential for major, non-recoverable, adverse effects
All past, present, and future military activities described in this chapter are grouped together under Military Operations. It should be noted that the individual military actions tend to affect different resources and when grouped together, may be misinterpreted to mean that each military activity would affect all resources.

Once a value was assigned to each resource for an individual action, an assessment was conducted to determine whether there would be cumulative impacts to the resource area in relation to the proposed action. A resource having a value of “NE” was not analyzed since there is no potential for cumulative impacts. Cumulative impacts were considered likely to occur for the following actions:

- Actions occurring at the same or overlapping areas at the same or similar time.
- Actions occurring in the vicinity at the same or similar time.
- Actions occurring at the same or overlapping areas at some other time.

The same valuation process was used to determine the overall cumulative impact to a resource. It is important to note that even if a resource was given a value of “**” or “***” for an individual action, it does not automatically generate a cumulative impact of “**” or “***.” This is due to difference in space and time from other actions or the resource that is potential affected. For instance, as discussed in Chapter 1, regulatory permits can be granted for certain actions that involve the likely “taking” of protected species, such as marine mammals, sea turtles, or migratory birds. Even these individual effects would be considered moderate to severe (depending on the action and species affected). Regulations are in place to ensure the continued survival of the respective species. Moreover, the implementation of mitigation and protective measures for individual actions has the potential to further reduce the cumulative impact.

### 4.8.6.2.1 Sediment Contamination (Sediment Quality)

**USWTR OEIS/EIS Conclusions**

The accumulation of expended materials from USWTR training activities that settle on the ocean bottom may be covered by sediment deposition or benthic invetebrates over time. With regard to the direct, indirect, and cumulative impacts of the proposed action, impacts are expected to be temporary in the marine environment. Most of the materials would be harmless, but some would consist of metals such as lead. However, none of the materials accumulating at these densities would measurably affect sediment quality.

The EA for the Canadian Forces Maritime Experimental and Test Ranges (CFMETR) near Nanoose, British Columbia, was completed in 2005 by Environmental Sciences Group, Royal Military College of Canada (ESG). This document analyzed chemical effects associated with expendable components from activities involving sonobuoys, torpedoes, EMATTs, and ADCs (ESG, 2005). Specifically, the analysis focused on lead, copper, lithium, and Otto fuel. The
document stated that metal contaminants were most likely to concentrate in fine-grained particulate matter, especially when smaller than 63 µm. The findings of the EA demonstrated that CFMETR operations did not cause a measurable effect on sediment quality (ESG, 2005).

Another study was conducted to determine whether the operation of the Dabob Bay Range Complex in Washington state has had an adverse effect on sediment and water quality (DoN, 2001c). Concentrations of six metals – cadmium, copper, lithium, lead, zinc, and zirconium – in Dabob Bay sediment and water were compared with those in similar samples from other locations and with environmental standards. The study concluded that, although the range has been in operation for many decades, these six metals that could have been released by past range activities are not elevated in the range.

Therefore, based on the conclusions of the CFMETR EA and because USWTR active sonar activities involve activities similar in nature to those analyzed in the EA, and based on the findings of the Dabob Bay Range Complex study, it is anticipated that metal contaminants from materials expended during USWTR operations have the potential for a minor, but recoverable impact to sediments. No significant impacts on bottom topography and sediment quality from USWTR training activities are anticipated.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

The expending of materials at sea, over a long period of time, can cause potential incremental effects to sediment quality. However, the USWTR site and actions previously described in this chapter are occurring in the open ocean, and chemical releases would rapidly dilute in the water; thus, accumulation of chemicals in sediments is not likely to occur. Therefore, it is expected that although there would be a potential for minor incremental, but recoverable, adverse cumulative effects, these effects would not be significant as they would be localized and temporary. No significant cumulative impacts to sediments from expended materials are anticipated.

**4.8.6.2.2 Marine Debris (Marine Habitat)**

**USWTR OEIS/EIS Conclusions**

Expended materials include any man-made object expended, disposed of, or abandoned that enters the coastal or marine environment. It may enter directly from a ship, or indirectly when washed out to sea via rivers, streams, and storm drains. Types of expended materials include plastics, abandoned vessels, glass, metal, and rubber. These materials can injure or kill marine life, interfere with navigation safety, create adverse economic effects to shipping and coastal industries, and pose a threat to human health (NOAA, 2009).

Most weapons and devices used during USWTR training exercises would be removed at the conclusion of the exercises. However, some training devices would be discarded at sea. This equipment can be broadly characterized for analysis purposes into the following groups:
Items related to torpedo use, including control wire, ballast, rocket airframe, air-launch accessories, and parachutes

Sensing devices such as XBTs and sonobuoys

Acoustic device countermeasures

Targets

Due to the small size and the weight of the materials, these components are not expected to float at the water surface or remain suspended within the water column. Over time, the expended materials from USWTR training activities will settle to the ocean bottom and may be covered by sediments or benthic invertebrates. Training activities will not likely occur in the exact same location each time and, due to ocean currents, the materials will not likely settle in the same location.

The National Marine Debris Monitoring Program found that land-based sources are responsible for approximately 49 percent of marine debris items along U.S. beaches, ocean-based sources are responsible for approximately 18 percent of debris, and the remaining 33 percent of debris is categorized as general source debris (IMDCC, 2008). The Navy has not been identified as a major land-based or ocean-based source of marine debris, and Navy divers partner with ocean resource agencies to remove derelict debris while enhancing their own field training through the DoD’s Innovative Readiness Training (IMDCC, 2008).

During the 2007 International Coastal Cleanup Campaign event, worldwide volunteers discovered 235 animals entangled in expended materials. As shown in Table 4.8-6, expended fishing line was responsible for nearly half of all entanglements, followed closely by rope and fishing nets (Ocean Conservancy, 2008). The cleanup campaign is an annual effort by the Ocean Conservancy and the summary of animals entangled in expended materials is published annually.

As concluded above in Subchapter 4.8.6.2.1, it is anticipated that metal contaminants from materials expended during USWTR operations have the potential for a minor, but recoverable impact to sediments. No significant impacts on bottom topography and sediment quality from USWTR training activities are anticipated.

The Navy recognizes that cumulative impacts on ocean water quality are substantial, and increasing. As described in Subchapter 4.2, most of the potentially hazardous constituents of expended USWTR training materials are not released in, or do not long remain in, a biologically available form. While the potential to further minimize releases of potentially hazardous constituents during Navy training is low, the Navy overall has substantially reduced its releases of potentially hazardous substances in compliance with governmental regulations and its own stewardship initiatives and will continue to identify stewardship opportunities to further reduce its effects on ocean water quality.
Table 4.8-6
Summary of Animals Entangled in Expended Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Invertebrates</th>
<th>Fish</th>
<th>Reptiles</th>
<th>Birds</th>
<th>Mammals</th>
<th>Amphibians</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balloon ribbon/string</td>
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<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>5</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Building Materials</td>
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<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
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<td>0</td>
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<td>4</td>
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<td>Totals</td>
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<td>81</td>
<td>30</td>
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<td>235</td>
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<td>Total Percentage</td>
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<td>4.7%</td>
<td>34.5%</td>
<td>12.8%</td>
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</table>

Source: Ocean Conservancy, 2008

USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The expending of materials at sea, over a long period of time, can cause potential incremental effects to the marine habitat. However, the USWTR site and actions previously described in this chapter are occurring in the open ocean and the expended components are not expected to float at the water surface or remain suspended within the water column. Therefore, it is expected that although there would be a potential for minor incremental, but recoverable, adverse cumulative effects, these effects would not be considered significant. No significant cumulative impacts to the marine habitat from expended materials are anticipated from the selection of any alternative.

4.6.8.2.3 Water Quality

USWTR OEIS/EIS Conclusions

Subchapter 4.1 analyzed the potential effects to water quality from sonobuoy, ADC, EMATT batteries, and OTTO II fuel combustion byproducts associated with torpedoes. XBTs were not analyzed since they do not use batteries. Moreover, the scuttling of sonobuoys were not analyzed since, once scuttled, their electrodes are largely exhausted during operations and residual constituent dissolution occurs more slowly than the releases from activated seawater batteries. As such, only the potential effects of batteries on marine water quality in and surrounding the sonobuoy operation area was completed. It was determined that there would be no significant
impact to water quality from seawater batteries, lithium batteries, and thermal batteries associated with scuttled sonobuoys under any alternative.

ADCs and EMATTs use lithium sulfur dioxide batteries. The constituents in the battery react to form soluble hydrogen gas and lithium dithionite. The hydrogen gas eventually enters the atmosphere and the lithium hydroxide dissociates, forming lithium ions and hydroxide ions. The hydroxide is neutralized by the hydronium formed from hydrolysis of the acidic sulfur dioxide, ultimately forming water. Sulfur dioxide, a gas that is highly soluble in water, is the major reactive component in the battery. The sulfur dioxide ionizes in the water, forming bisulfite (HSO₃⁻) that is easily oxidized to sulfate in the slightly alkaline environment of the ocean. Sulfur is present as sulfate in large quantities (i.e., 885 mg/L) in the ocean. Thus, it was determined that there would be no significant impact to water quality from lithium sulfur batteries associated with scuttled ADCs and EMATTs from the selection of any alternative.

OTTO II fuel is combusted in the torpedo engine and the combustion byproducts are exhausted into the torpedo wake, which is extremely turbulent and causes rapid mixing and diffusion. Combustion byproducts include carbon dioxide, carbon monoxide, water, hydrogen gas, nitrogen gas, ammonia, hydrogen cyanide (HCN), and nitrogen oxides. All of the byproducts, with the exception of hydrogen cyanide, are below the EPA standards for marine water quality criteria. Hydrogen cyanide is highly soluble in seawater and dilutes below the EPA marine water quality criterion within 6.3 m (20.7 ft) of the torpedo. Therefore, it was determined there would be no significant impact to water quality as a result of the use of OTTO II fuel under the selection of any alternative.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Effects to water quality from past, present, and reasonably foreseeable future activities would most likely occur from the degradation of expended materials and increased turbidity due to localized disturbances of ocean bottom sediments caused by construction, dredging, and oil and gas industry activities. However, these effects would most likely be minor and temporary and would not have a significant impact on marine water quality. Moreover, water quality conditions would most likely return to normal after project completion. Therefore, when combined with construction, dredging, and oil and gas industry actions, USWTR active sonar activities are not expected to significantly impact marine water quality. Cumulative impacts would be minor, but recoverable and would not be significant.

**4.6.8.2.4 Marine Plants and Algae**

**USWTR OEIS/EIS Conclusions**

No effects to marine plants and algae are anticipated from active sonar since plants and algae are acoustically transparent. *Sargassum* mats are easily identified and will be avoided wherever
possible. Therefore, it was determined that there will be no adverse effects to marine plants and algae from active sonar.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Other activities described earlier in this subchapter which would most likely have the greatest affect on marine invertebrates are dredging, commercial fishing, environmental contamination and biotoxins. USWTR active sonar activities would be relatively isolated due to the large expanses of area in between activity locations. As such, minor, but recoverable cumulative impacts to marine plants and algae could occur.

**4.8.6.2.5 Marine Invertebrates**

**USWTR OEIS/EIS Conclusions**

According to the NRC (2003), there is very little information available regarding the hearing capability of marine invertebrates. However, since acoustic transmissions are brief in nature, effects to marine invertebrates from active sonar are not anticipated. In addition, there is a huge variation in marine invertebrates, including numbers, species, sizes, and orientation and range from the detonation point, which makes it very difficult to accurately predict effects at any specific site. Most invertebrates experience large number of natural mortalities especially since they are important foods for fish, reptiles, birds, and mammals. Any level of mortality caused by USWTR active sonar activities would most likely be insignificant to the population as a whole. Therefore, it was determined that there will be no adverse effects to marine invertebrates from active sonar activities.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Other activities described earlier in this subchapter which would most likely have the greatest effect on marine invertebrates are dredging, commercial fishing, environmental contamination and biotoxins. USWTR active sonar activities would be relatively isolated due to the large expanses of area between activity locations. As such, there is a potential for minor, but recoverable, cumulative impacts to marine invertebrates. Impacts would be temporary and localized and would not be considered significant.

**4.8.6.2.6 Marine Fish**

**USWTR OEIS/EIS Conclusions**

Studies have indicated that acoustic communication and orientation of fish may be restricted by sound regimes in their environment. However, most marine fish species are not expected to be able to detect sounds in the mid- and high- frequency range of the operational sonars used in training on the USWTR, and therefore, the sound sources do not have the potential to mask key
environmental sounds. The few fish species that have been shown to be able to detect mid-frequencies do not have their best sensitivities in the range of the operational sonars. Additionally, vocal marine fish largely communicate below the range of mid- and high-frequency levels used in training on the USWTR.

Moreover, there is no information available that suggests exposure to non-impulsive acoustic sources results in significant fish mortality on a population level. Mortality has been shown to occur in one species, a hearing specialist; however, the level of mortality was considered insignificant in light of natural daily mortality rates. Experiments have shown that exposure to loud sound can result in significant threshold shifts in certain fish that are classified as hearing specialists (but not those classified as hearing generalists). Threshold shifts are temporary, and it is not evident that they lead to any long-term behavioral disruptions. The data presented in Subchapter 4.2 indicates that there are no long-term negative effects on marine fish from underwater sound associated with sonar activities. Further, while fish may respond behaviorally to mid and high-frequency sources, this behavioral modification is only expected to be brief and not biologically significant.

Therefore, it was determined that there would be no significant impact to fish populations as a result of active sonar activities from training on the USWTR.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

The overall effect on fish stocks would be negligible compared to the impact of commercial and recreational fishing at the USWTR site. As previously discussed, the SAFMC has recently designated eight MPAs along the southeastern coast of the U.S. Designated MPAs occur within the proposed boundaries of Sites A and B (see Figure 3.2-1 and Figure 3.2-2). Within the MPAs, fishing or retention of snapper-grouper species, and any deployment of shark-bottom longline fishing gear are prohibited (SAFMC, 2007c; NMFS 2008b, 2009a). However, the North Florida MPA occupies only approximately 22% of Site A and the Charleston Deep Artificial Reef MPA occupies only approximately 4% of Site B. Commercial and recreational fishing would not be restricted throughout the remainder of the USWTR site, outside the designated MPA.

After completion of an active sonar activity, repopulation of an area by fish should take place within a matter of hours. Even for fish that are able to detect mid-frequency sounds, both the fish and vessels are moving, which would mean a minor exposure to the mid-frequency sounds being emitted by the sonar. Also, any exposure to mid-frequency active sonar will only be temporary (i.e., would not occur for long increments of time) and is considered transient in nature. Consequently, the exposure would be temporary and not considered significant. As such, no long-term changes to species abundance or diversity, loss or degradation of sensitive habitats, or effects to threatened and endangered species are expected. There is the potential for minor, but recoverable cumulative impacts to marine fish from training on the USWTR.
4.8.6.2.7 Essential Fish Habitat (EFH)

**USWTR OEIS/EIS Conclusions**

EFH types include live/hard bottom, soft bottom, estuaries, reefs, wrecks, inshore areas, oyster reefs, and vegetated bottom. Impacts to EFH as pertinent to the area covered by this EIS/OEIS may arise from:

- Fishing gear
- Dredging
- Boat groundings
- Coastal construction
- Oil and hazardous materials
- Exotic species
- Toxic algal blooms
- Storm surges and wind generated waves

Mobile fishing gear such as trawls and fixed fearing gear including gillnets and traps/pots can affect EFH. Trawling changes the benthic habitat through direct contact, alters the food web by taking target and non-target species, and changes the chemistry of the water column (NMFS, 2007h). Mobile gear fisheries that affect EFH include bottom trawling related to foreign fisheries, in state waters, and domestic groundfish fisheries. Fixed gear also impacts the benthic community and EFH through these effects. The fixed fisheries with potential to affect EFH includes trap/pot fisheries for lobster, crab, and shrimp; fixed gear fisheries for American lobster, red crab, Jonah crab, hagfish, and black sea bass; and anchored gillnet fisheries that target monkfish and dogfish (NMFS, 2007h).

Dredging also changes EFH and affects prey on and in marine sediments. Large amounts of sediment may be re-suspended, which can change the chemistry and physical composition of the water column. These actions can cause overall changes to the benthic community if they occur over long periods and widespread areas (NMFS, 2007h).

Like dredging, vessel groundings can directly alter the physical structure of the benthic habitats and cause direct mortality to organisms living on and in the sediments. These effects occur to a site-specific, localized area (NMFS, 2007h). There are no documented effects to EFH from vessel groundings and ecosystem wide effects are not expected from such events.

Development of ports and other infrastructure has occurred throughout the coastal zone along the U.S. Atlantic coast and Gulf of Mexico. These projects also have the potential to affect EFH through the alteration of physical structure, direct mortality to organisms, re-suspension of sediments, chemical and physical modification of the water column, and local changes in
community structure (NMFS, 2007h). Similar to vessel groundings, the effects are site-specific and restricted to the local area. Ecosystem wide effects not expected from the construction of ports (NMFS, 2007h).

The use of oil and hazardous materials in the marine environment creates opportunities for spills and pollution to occur. Within the proposed USWTR sites, spills range from the release of small amounts of fuel to thousands of gallons of oil. Large spills cause direct mortality to birds, fish, sea turtles, and marine mammals; alter the chemical composition of the water column; and change the structure of the benthic community (NMFS, 2007h). Habitats that may be affected include coastal, inshore, and offshore areas from accidental release by vessel accidents, ruptured pipelines, and oil platform spills. Oil spills may also affect pelagic communities through the formation of surface slicks. Other hazardous pollutants, such as metal contaminants, pesticides and herbicides, and chlorine, can also be found in the water column and persist in the sediments of coastal, inshore, and offshore habitats (NMFS, 2007h).

Exotic species are introduced into the marine environment accidentally and intentionally. These introductions alter the physical and biological characteristics of the ecosystem habitats. Non-native species that have been introduced include finfish, shellfish, plants, and parasites. The issues related to exotics include increased competition, niche overlap, predation on native organisms, decreased genetic integrity, and transmission of disease. There are documented cases where exotic species have pushed native species towards extinction. The scientific and regulatory communities are working to develop ways to combat exotics; methods include producing sterile organisms and securing facilities and infrastructure that has the potential to introduce non-native species (NMFS, 2007h).

Toxic algal blooms have occurred along the East Coast of the U.S. in conjunction with the loading of nutrients into the water column and benthic habitats. These blooms change the physical and chemical composition of the water column and can cause mortality to marine organisms. Toxic algal blooms include events related to toxic microscopic algae and non-toxic seaweeds, which can grow uncontrollably and displace native species, alter habitat suitability, and deplete oxygen levels. Communities generally rebound and are adapted to the intermittent occurrence. If they do not, then the marine food web is affected by adverse effects on eggs, corals, sponges, sea turtles, seabirds, and marine mammals (NMFS, 2007h).

Storm surges and wind generated waves also have the potential to affect EFH. The potential exists for surges and waves to alter the bottom and change the characteristics of the water column (NMFS, 2007h). The effects, however, are not generally extensive and do not extend to the entire ecosystem.

As discussed in Subchapter 4.2.3, the installation of the range, including the placement of the nodes and the burial of the interconnect and trunk cables, may adversely affect live/hard bottom EFH and HAPC in the area. The range installation may also adversely affect, but not substantially affect, benthic substrate, pelagic Sargassum, and nearshore EFH. In addition, expended materials resulting from torpedo exercises and the use of sensing devices,
countermeasures, and targets may adversely affect benthic substrates and live/hard bottom EFH and HAPC. No effects to EFH are anticipated from active sonar since acoustic transmissions are brief in nature. Therefore, there will be no significant effect to EFH from active sonar activities.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

As detailed in Subchapter 4.2.3, adverse impacts to EFH may occur as a result of the installation of the USWTR and the training exercises conducted on the range. The most sensitive habitat designated as EFH to these activities would be live/hard bottom. Live/hard bottom has been identified in areas throughout the range, particularly along the continental shelf-edge, and supports an array of species, primarily belonging to the snapper-grouper complex, providing food, shelter, and spawning grounds. In addition, benthic habitats contained within both the proposed JAX and Charleston USWTR sites have been recently designated as snapper-grouper MPAs based on their importance as areas of spawning for many species. The installation of the range, though avoiding areas of live/hard bottom to the extent practicable for both environmental and engineering reasons, may require the placement of some nodes on and the laying of internode cables through these sensitive habitats. In addition, materials expended during training exercises over the range, including sensing devices and countermeasures (e.g., XBTs, sonobuoys, and ADCs), targets (e.g., EMATTs), and lead ballasts from torpedoes, may settle in areas of live/hard bottom, resulting in adverse impacts to these habitats over time. Expended materials may also occur in the vicinity of any of the proposed USWTR ranges as a result of other military exercises described in the Jacksonville Range Complex EIS/OEIS and the Cherry Point Range Complex EIS/OEIS. To address these potential impacts, the Navy has initiated consultations with NMFS in accordance with the MSA.

**4.8.6.2.8 Sea Turtles**

**USWTR OEIS/EIS Conclusions**

Sea turtles experience a number of natural and anthropogenic threats throughout their diverse life history. Natural threats include hurricanes, cold stunning, and biotoxin exposure. Sand accretion and rainfall associated with hurricanes and waves generated from storm surges can damage sea turtle nesting habitat extensively. For example, in 1992, all of the eggs over a 145 km (90 mile) length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton et al., 1994). Man-made threats on land include beach erosion, armoring, nourishment, and cleaning; artificial lighting; increased human presence; recreational beach equipment and driving; coastal construction; planting exotic dune and beach vegetation; and poaching. Anthropogenic threats at sea include entanglement in gear of commercial fisheries, ingestion of marine debris, and strikes by vessels. Sea turtles entangled in fishing gear generally experience a reduced ability to feed, dive, surface/breathe, or perform any other behavior essential to survival. They may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow. In the USWTR site, commercial fisheries affect in particular loggerhead, leatherback, green, and Kemp’s ridley sea turtles. The
following paragraphs describe the effects from fisheries to each of these species and efforts NMFS has taken to reduce their mortality in the industry operations (NMFS, 2007n).

Thousands of loggerhead sea turtles interact with commercial fisheries each year. Basin-wide average bycatch rates, extrapolated to account for total longline effort in the Atlantic and Mediterranean, yielded a minimum estimate of over 200,000 loggerheads caught in these waters in 2000. Although not all of these interactions would have been lethal, thousands of potential turtle mortalities may have occurred based on a Hawaii-based study by NMFS suggesting a 27 to 42 percent immediate and delayed post-hooking mortality rates for loggerheads (NMFS-SEFSC, 2001). Observer records indicate that an estimated 6,900 loggerheads were captured by U.S. fishermen between 1992 and 1998. An estimated 43 of these turtles were dead (NMFS, 2007n).

Loggerheads are also caught in coastal waters of the east coast, for example, in pound net gear and trawls in the Mid-Atlantic and Chesapeake Bay; in gillnet fisheries in the Mid-Atlantic, and in Northeast sink gill net fisheries. Annual peaks in loggerhead strandings in the Mid-Atlantic regularly occur in early summer and late fall, coinciding with increased gillnet activity. Observers have documented lethal takes of loggerheads and Kemp’s ridleys in these fisheries (TEWG, 2000). Shrimp trollers, however, represent the most significant source of incidental takes from commercial fisheries, and are believed to be the largest single source of mortality in southeastern U.S. waters. Magnuson et al. (1990) estimated 5,000 to 50,000 loggerheads are killed each year by the offshore commercial shrimp fleet in the southeastern Atlantic and Gulf of Mexico. Epperly et al. (2002) estimated 62,294 annual loggerhead mortalities in the Gulf of Mexico and southeast U.S. Atlantic food shrimp fishery with current regulations, and 3,948 loggerhead mortalities with new TED regulations, once enacted.

Of the Atlantic turtle species, leatherbacks may be the most vulnerable to entanglement in fishing gear because of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to organisms that collect on buoys and buoy lines at or near the surface, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets (used in various fisheries) and to capture in trawl gear (e.g., shrimp trawls). According to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992 and 1999, of which 88 were released dead. Since the U.S. fleet accounts for only five to eight percent of the longline vessels in the Atlantic Ocean, the impact from the takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages. Other fisheries that endanger leatherback sea turtles include the trap/pot, blue crab, lobster, stone crab, gillnet, sink net, and pound net fisheries (NMFS, 2007n).

In addition to the natural threats of other sea turtles, green turtles appear susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle’s body. Juveniles are most commonly affected. The occurrence of these tumors may impair foraging, breathing, or swimming and lead to death. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries
has recorded takes of green turtles. Strandings of green turtles in Virginia indicate that they may also be susceptible to interactions with the state pound net fishery (NMFS, 2007n).

Takes of Kemp’s ridley turtles have been recorded by sea sampling coverage in the Northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries. Among U.S. commercial fisheries, the southeast shrimp trawl fishery is known to take the highest number of leatherback sea turtles with an estimated 640 leatherback captures annually. Approximately 25 percent (160) of the captured animals die from drowning (Henwood and Stuntz, 1987). Although not the largest known source of anthropogenic mortality, gillnet and crab pot fishing gear has taken Kemp’s ridley sea turtles. Of the juveniles caught by fishing, four fishermen caught an estimated four percent in gill nets and 0.2 percent by crab pots. Tag returns for adult turtles indicate that seven percent were caught in gill nets (Marquez, 1989).

To address the threats to sea turtles, NMFS has identified ways to reduce mortality in commercial fisheries. For example, the agency has worked with the industry to develop and use turtle excluder devices (TEDs) in trawls to reduce turtle takes. These devices are particularly beneficial to the smaller sea turtle species (NMFS, 2007n). To protect the larger leatherback species, NMFS has established a Leatherback Conservation Zone, which restricts, when necessary, shrimp trawl activities from off the coast of Cape Canaveral, Florida to the Virginia/North Carolina border. NMFS can quickly and temporarily close the area or portions it when high concentrations of leatherbacks are present, to shrimp fishermen who do not use TEDs with an escape opening large enough to exclude leatherbacks. Additional measures include fishery closures during particular seasons and in specified geographic locations, seasonal restrictions on fishing gear, and reporting and monitoring requirements for fisheries such as pound netting. The agency conducts stock assessments and convenes groups to develop and implement take reduction plans. NMFS also conducts outreach efforts to the recreational fishing community (NMFS, 2007n).

All of the turtles species found in the USWTR study area are ESA-listed species. As such, the Navy’s has initiated early consultation with NMFS in accordance with Section 7 of the ESA. Acoustic analysis for mid- and high-frequency active sonar activities was not performed for sea turtles due to the fact that sea turtles appear to be most sensitive only to low frequencies.

Estimated sea turtle exposure from explosive sources are described in the VACAPES, Cherry Point, JAX, and AFAST environmental impact statements, with the explosive criteria provided in Table 4.8-7. These analyses identified the potential for sea turtles to be exposed to sound from active sonar activities involving an explosive source sonobuoy.
Table 4.8-7

Explosive Criteria Used for Estimating Sea Turtle Exposures

<table>
<thead>
<tr>
<th>Effect</th>
<th>Criteria</th>
<th>Metric</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>Onset extensive lung injury</td>
<td>Goertner modified positive impulse (function of depth and animal weight)</td>
<td>30.5 psi-ms</td>
</tr>
<tr>
<td>Physiological</td>
<td>Onset slight lung injury/PTS</td>
<td>Goertner modified positive impulse indexed to 13 psi-ms</td>
<td></td>
</tr>
<tr>
<td>Behavioral</td>
<td>TTS (Temporary Threshold Shift)</td>
<td>Greatest energy flux density level in any 1/3-octave band above 100 Hz - for total energy over all exposures</td>
<td>182 dB re 1 µPa2-s</td>
</tr>
<tr>
<td>Behavioral</td>
<td>TTS</td>
<td>Peak pressure over all exposures</td>
<td>23 psi</td>
</tr>
</tbody>
</table>

Notes: dB 1 µPa2-s – decibel referenced to 1 micropascal squared second; Hz – hertz; psi-ms = pounds per square inch-millisecond;

A summary of turtle acoustic exposures at each site is provided in Table 4.8-8. As indicated, no acoustic exposures resulting in a physiological effect are anticipated at any location. In the case of single explosions, behavioral effects are expected to be limited to short-term startle effects. Exposures numbers were rounded to 1 if the result was equal to or greater than 0.5. When the potential impacts due to sonar activities are included with the potential impacts due to range complex activities, they may affect sea turtles in territorial waters. Additionally, other actions listed in Subchapter 4.8.4 could potentially affect sea turtles. Potential cumulative effects include avoidance of a larger area of habitat, or increased stresses from multiple, successive, or prolonged behavioral responses.

Table 4.8-8

Estimated Sea Turtle Acoustic Exposures from Explosive Source Sonobuoys

<table>
<thead>
<tr>
<th>Species</th>
<th>Mortality</th>
<th>PTS</th>
<th>TTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JAX/CHASN</td>
<td>CHPT</td>
<td>VACAP ES</td>
</tr>
<tr>
<td>Loggerhead sea turtle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kemp’s ridley sea turtle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Leatherback sea turtle</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hardshell sea turtles²</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
* Indicates an exposure greater than or equal to 0.05, therefore is considered a “may affect” for ESA listed species
1. This category does not include Kemp’s ridley sea turtles in the Gulf of Mexico. They are included in the hardshell sea turtle class.
2. This category includes green, hawksbill, and unidentified hardshell species for all regions. It also includes Kemp’s ridley sea turtles in the Gulf of Mexico, and may include extralimital occurrences of olive ridley turtles along the Atlantic coast.

Source: DoN, 2008d, 2008g, 2008i.
Similar to marine mammals, sea turtles are subject to entanglement in expended materials, particularly anything incorporating loops or rings, hooks and lines, or sharp objects. Possible expended materials from USWTR activities include sonobuoys, torpedoes, and ADCs. However, it was determined in Subchapter 4.2.4 that the overall possibility of a sea turtle ingesting parachute fabric or becoming entangled in cable assemblies is very remote. Furthermore, it is unlikely that a sea turtle would come into direct contact with a torpedo, torpedo flex hose, or ADC. As such, it was determined there would be no significant impact to sea turtles as a result of expended materials during active sonar activities under the No Action Alternative, Site A, Site B, Site C, or Site D.

There is a growing concern about the impacts of climate change on sea turtles. Responses of sea turtles to climate change are difficult to interpret due to the confounding impacts of natural responses and human influences. Climate change will likely increase the foraging range of leatherback turtles farther into temperate and boreal waters as isotherms shift (James et al., 2006c; McMahon and Hays, 2006). Large-scale climatic events may affect turtles by loss of nesting beaches as sea levels rise (Vagg and Hepworth, 2006). Earlier nesting and longer nesting seasons are being correlated with warmer sea surface temperatures (Weishampel et al., 2004; Hawkes et al., 2007), which are expected to continue to rise with climate change.

Sea turtles, in particular, are predicted to be uniquely sensitive to unusually rapid global warming (Mrosovsky et al., 1984; Davenport, 1989) because of their slow growth to maturity, Temperature-dependent sex determination (TSD), and natal beach homing. Because of TSD, increases in mean nest temperatures of no more than a few tenths of a degree (C) would significantly bias reproduction in favor of the production of females. Due to the rapid changes in climate which are expected in the next century (0.6 - 8.0 C, Janzen, 1994) sex ratios in sea turtles and other reptilian species may be radically altered. While these species have coped with climate changes before in their evolutionary history, proximate shifts in climate change are expected to be rapid and may preclude successful gradualist responses that functioned historically, like active modification of geographic range (Wyman, 1991; MacDonald & Sertorio, 1990; Root & Schneider, 1993; Peters et al., 1992; Kareiva et al., 1993). Geographic expansions in the breeding ranges are also unlikely due to natal homing and the lack of suitable nesting habitat. While these taxa have experienced extreme climatic temperature changes in the geologically recent past, their delicate status (most are threatened or endangered) means that natural populations of these species could be negatively effected by climate changes long before conditions become as severe as in the past (Mrosovsky and Provancha, 1992).

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

The Navy has determined that sea turtles may experience a cumulative effect from USWTR activities; however they will not likely adversely affect sea turtle populations. As mentioned above, the Navy has entered early consultation with NMFS in accordance with Section 7 of the ESA. In addition, sea turtles are more likely to be impacted from interaction with equipment used during fishery practices than from activities conducted during a naval active sonar activity.
While the estimates for the incidental catch of sea turtles in longline fisheries vary from year to year, approximately 800 to 3,500 sea turtles in the Atlantic interact with longline fisheries (Dietrich et al., 2007). The highest sea turtle interaction rates are in the Gulf of Mexico through the mid-Atlantic and Grand Banks (Dietrich et al., 2007). It is expected that the mitigation measures identified in Chapter 6 would be implemented to minimize any potential adverse effects to sea turtles. Moreover, the Navy is consulting with NMFS in accordance with Section 7 of the ESA for any potential effects active sonar activities may have on sea turtles. As such, there is the potential for moderate, but recoverable cumulative impacts to sea turtles. No significant cumulative impacts are anticipated.

4.8.6.2.9 Marine Mammals

USWTR OEIS/EIS Conclusion

In addition to underwater sound, activities that affect marine mammals include by-catch, ship strikes, and authorized takes. Changes in the environment from climate change induced by humans also threaten marine mammals. As discussed in Subchapter 4.8.3, the greatest threat to cetacean mortality and injury occurs in the commercial fishing industry. More whales die every year through entanglement in fishing gear than from any other cause. Gillnets, set nets, trammel nets, seines, trawling nets and longlines pose the biggest threat. Gillnets contribute a very high proportion of global cetacean bycatch because of their low cost and widespread use. In the northeast of the U.S., traps and pots are left in the water for extended periods of time. Whales may become entangled in the lines and have been observed swimming with portions of the gear wrapped around fins, flukes, the neck, and mouth. Animals may travel long distances over time before they free themselves of the gear or die from the entanglement (Angliss and Demaster, 1998). Scientists and the regulatory community have found that:

- Entanglements that caused serious injury most frequently involved humpback whales, followed by right whales, then minke and fin whales.
- Fatal entanglements most frequently involved minke whales, followed by humpback whales, right whales, and fin whales.
- Fatal entanglements were most frequently reported off the coast of Massachusetts. Additional fatal entanglements were reported off the coasts of North Carolina, Virginia, South Carolina, and Maine.

Johnson et al. (2005) studied 31 right whales and 30 humpback whales to determine specific types and parts of gear that these animals become entangled. Results of the study concluded that 89 percent of entanglements were attributed to pot and gill net gear. Of the suspected or known lethal entanglements, pot gear was involved in 18 percent and gill net gear was involved in 23 percent. Of the gear part identified, 81 percent of the involved entanglements were in either a buoy line or groundline. It was also noted that right whales gear attachment is primarily in the mouth (77.4 percent), while humpback whale gear attachment is primarily in the tail (53 percent).
and mouth (43 percent). During this study, it is known that four right whales and three humpback whales died following an entanglement. The gear types and parts identified as being involved in these mortalities were not drastically different from the gear involved with non-lethal outcomes (Johnson et al., 2005).

Programs targeted specifically to address the effects on large whales from commercial fisheries include a gear research and development program to reduce the amount of potentially hazardous gear in the water and the disentanglement network whose personnel work to locate, assess, and remove gear from entangled whales. Recommendations under the recovery plan specific for right whales to reduce commercial fishery interactions with whales include gear restrictions and modifications, research, and regulatory and enforcement actions (NMFS, 2007n).

Entanglements may also occur with recreational fishing gear. Little data exists for recreational fishing interactions with marine mammals. Large whale entanglements may also result from interactions with recreational fishing. Finfish recreational fisheries typically involve rod and reel and hand lines while traps/pots are common for the lobster and crab industry. The risk of entanglement in recreational gear is relatively small for marine mammals (NMFS, 2007n).

Marine mammals may be injured or killed from ship strikes throughout the world, including the USWTR study area. Since 1885, 292 ship strikes have been reported involving 11 different species. Of these documented cases, 198 were fatal, 48 included injury, 39 were unknown, and 7 showed no signs of injury (Jensen and Silber, 2004). In many injury cases, however, the fate of the whale is unknown (NMFS, 2007n).

The most vulnerable marine mammals are those whose behavioral characteristics cause them to remain at the surface for extended period of time (e.g. fin whale), rather than merely those that remain at the surface to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). Laist et al. (2001) identified 11 species known to be hit by ships. Of these species, fin whales are struck most frequently; right whales, humpback whales, sperm whales, and gray whales are hit commonly. The review, which involved 58 known vessel collisions revealed that while all sizes and types of vessels can hit and injure whales, the most severe injuries result from collisions involving ships that are greater than 80 m (262 ft) in length or traveling at speeds exceeding 24 km/hr (13 kt) (Laist et al., 2001).

Given the depleted nature of many of these stocks, this effect represents a potentially significant source of risk. For example, the total estimated ship strike mortality and serious injury for the endangered right whale between 1999 and 2003 was estimated at 1.0 whale per year (U.S. waters 0.8; Canadian waters, 0.2) (Waring et al., 2006). The behavior of right whales makes them particularly vulnerable to collisions. Right whales swim close to shore and in or adjacent to major shipping lanes. In addition, they spend much of their time at the surface, skim feeding, resting, mating, and nursing. These behaviors can occur for periods of an hour or more (NMFS, 2007n). Calves, which spend most of their time at the surface due to their undeveloped diving capabilities, are particularly vulnerable. It is likely that these numbers underestimate the true
mortality from ship strikes because experts generally believe that many ship strikes go unreported or undetected (NMFS, 2007n).

The risk of such strikes is high near the Northeast seaboard's busiest ports and shipping lanes, some of which are located near preferred habitat of whales. For example, the main shipping lane to Boston traverses the Stellwagen Bank National Marine Sanctuary, a major feeding and nursery area for several species of baleen whales. Similarly, Cape Cod Canal, another major channel for shipping along the New England coast, provides passage from Buzzards Bay to Cape Cod Bay, an area known for large whale activity (Hoyt, 2001). In southeastern waters, shipping channels associated with Jacksonville and Fernandina, Florida and Brunswick, Georgia bisect the area that contains the highest concentration of whale sightings within right whale critical habitat. These channels and their approaches serve several commercial shipping ports and military bases (NMFS, 2007n).

A number of initiatives have been implemented to reduce potential interactions between marine mammals and ships (NMFS, 2007n). Perhaps the most comprehensive effort focuses on right whales. A mandatory ship reporting system provides information to mariners entering right whale habitat through periodic notices and aerial surveys notify mariners of right whale sighting locations. Other support includes shipping industry liaisons, recovery team recommendations, and ESA Section 7 consultation work (NMFS, 2007n). In an effort to direct shipping traffic away from areas of high right whale occurrence, recommended routes were charted in November 2006 for four locations to reduce the likelihood of ship collisions. These locations include Fernandina, Florida; Jacksonville, Florida; Brunswick, Georgia; and Cape Cod Bay, Massachusetts (NOAA, 2008). Additionally, on July 1, 2007, NOAA and the USCG implemented a shift in the Traffic Separation Scheme servicing Boston to reduce the threat of vessel collisions with right whales and other whale species. The realignment is expected to result in a 58 percent reduction in the risk of ship strikes to right whales, and an 81 percent risk reduction in ship strikes of other large whale species occurring in the area (NOAA, 2008). NMFS has established regulations to implement a 18.5-km/hr (10-NM/hr) speed restriction for all vessels 19.8 m (65 ft) or longer in certain locations along the east coast of the U.S. Atlantic seaboard at certain times of the year. The purpose of the regulations is to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships. Exempted from the rule are state enforcement vessels and U.S. government vessels that will be expected to adhere to guidance provided under ESA Section 7 consultations. The rule also contains a provision exempting vessels from speed restrictions in poor sea and weather conditions. Canada has taken similar measures including designation of conservation areas, implementation of a Vessel Traffic System in the Bay of Fundy similar to NOAA’s EWS, and the movement of shipping lanes away from high densities of right whales (NMFS, 2007n).

Research is also continuing in areas related to whale and ship interactions. Efforts are focused on understanding marine mammal biology and ecology and its implications for conservation and management in this area. Particular projects have focused on understanding behavior around vessels and developing new technologies to improve management of vessel-whale interactions (NMFS, 2007n).
Climate change caused by increasing greenhouse gas concentrations from human activities has raised the concern of additional pressures on marine mammals (Learmonth et al., 2006). Key changes in the climate may include increased precipitation and ocean temperature, decreased sea ice coverage, and increases and decreases in salinity (NMFS, 2007n). These effects in turn may influence habitats, food webs, and species interactions. Evaluations of the direct effects of climate change on whales are generally confined to cetaceans in the Arctic and Antarctic regions, where the impacts of climate change are expected to be the strongest. The possibility exists that the indirect effects of climate change on prey availability and cetacean habitat will be more widespread, and could affect marine mammals in the USWTR study area. For example, climate change could exacerbate existing stresses on fish stocks that are already overfished and indirectly affect prey availability (NMFS, 2007n). Additional effects include increased algal blooms and biotoxins and increased pollutant runoff and chemical contaminants from precipitation (NMFS, 2007n). Habitat shifts are another possible implication of climate change. Walther et al. (2002) examined recent shifts of marine communities in response to rising water temperatures, concluding that most cetaceans will experience roughly poleward shifts in prey distributions. For some marine mammal species, these small changes may have little material effect, but for species already vulnerable because of severe existing problems, like the North Atlantic right whale, these changes could be significant obstacles to species survival (NMFS, 2007n). Predicting responses of marine mammals to climate change are difficult to interpret due to the confounding impacts of natural responses and human influences. Large scale climatic events may affect the distribution and abundance of marine mammal species, either directly or indirectly, through alterations of habitat characteristics and distribution (Harwood, 2001; Forcada et al., 2005; Keiper et al., 2005; MacLeod et al., 2005; Shelden et al., 2005; Simmonds and Isaac, 2007).

Ocean acidification may occur from an increase of CO₂ dissolved in ocean water that creates carbonic acid. The CO₂ emissions are the result of human activity and have resulted in the ocean pH dropping from 8.16 to 8.05 since that late 1980s (University of California/San Diego, 2009). Ocean acidification potentially could result in the ability of sound in the water to travel greater distances, thereby increasing the amount of energy to which marine mammals and sea turtles may be exposed. The Navy’s quantitative analysis of acoustic sources affecting marine mammals and sea turtles is based on the best available science; e.g., for sonar, modeling involved analysis in areas based on potential activities and transmission loss (DoN, 2009k). In response to a petition from the Center for Biological Diversity, USEPA stated on January 16, 2009 that it will initiate an evaluation of ocean acidification impacts to determine whether the current water quality criterion for marine pH should be modified to address ocean acidification (USEPA, 2009).

Authorized takes of marine mammal species include scientific research and subsistence use. Discussion of takes associated with scientific research is included in Subchapter 4.8.3. The subsistence hunting of marine mammals by Native Americans in U.S. waters generally occurs in the Pacific Ocean. Potential impacts resulting from the proposed activity will be limited to individuals of marine mammal species located off the East Coast, and will not affect Arctic
Acoustic analysis was performed in order to estimate the effects associated with active sonar use. Chapter 4 discusses the methodology used to measure these effects in detail. The results of acoustic analysis indicates that 144 ESA-listed marine mammals may be exposed to levels of sound likely to result in Level B harassment at the proposed USWTR Site A, 27 at the proposed USWTR Site B, 3 at the proposed USWTR Site C, and 316 at the proposed USWTR Site D. The results for all four alternative USWTR sites also indicate that no ESA-listed marine mammals would be exposed to levels of sound likely to result in Level A harassment. The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The Navy finds that ESA-listed species may experience a cumulative impact from USWTR activities; however, they are not expected to adversely affect the populations of ESA-listed species. As part of the environmental documentation for this OEIS/EIS, the Navy has entered into consultation with NMFS in accordance with Section 7 of the ESA. See Subchapter 4.3.8 for additional information.

Acoustic analysis indicates that 108,108 marine mammals (including ESA listed species) may be exposed to levels of sound likely to result in Level B harassment at the proposed USWTR Site A, 8,306 at the proposed USWTR Site B, 42,971 at the proposed USWTR Site C, and 152,815 at the proposed USWTR Site D. The exposure estimates represent the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. Acoustic analysis also indicates that 7 total marine mammals may be exposed to levels of sound likely to result in Level A harassment at the Proposed USWTR Site A, none at the proposed USWTR Site B, 2 at the proposed USWTR Site C, and 10 at the proposed USWTR Site D. Mitigation measures as presented in Chapter 6 would prevent the few exposures to sound levels causing PTS/injury (Level A harassment) that are expected to occur based upon the acoustic exposure estimates.

No mortalities are predicted due to USWTR active sonar activities. The exposure estimates for each alternative represents the total number of exposures and not necessarily the number of individuals exposed, as a single individual may be exposed multiple times over the course of a year. The Navy has determined that USWTR activities will have a negligible impact on marine mammal species or stock. The Navy has initiated consultation with NMFS in accordance with the MMPA for concurrence. See Subchapter 4.3.9 for additional information.

Subchapter 4.8.4.11 discusses other Navy actions where underwater sound is the primary environmental concern. Marine mammal exposures to Level A and Level B sound have been estimated for actions described in the VACAPES, Cherry Point, JAX, and AFAST environmental planning documents. In addition, other actions listed in Subchapter 4.8.5 for which exposures have not been calculated and may also occur within the USWTR alternative sites can contribute to the potential for multiple Level A or Level B sound exposures. Thus, marine mammals could experience Level A or Level B sound from multiple actions. Potential
cumulative effects include avoidance of a larger area of habitat, or increased stresses from multiple, successive or prolonged behavioral responses.

Marine mammals are also subject to entanglement in expended materials, particularly anything incorporating loops or rings, hooks and lines, or sharp objects. Most documented cases of entanglements occur when whales encounter the vertical lines of fixed fishing gear. Possible expended materials from USWTR activities include sonobuoys, torpedoes, and ADCs. It was determined in Subchapter 4.2.4 that the overall possibility of marine mammals ingesting parachute fabric or becoming entangled in cable assemblies is very remote. Furthermore, it is unlikely that a marine mammal would come into direct contact with a torpedo, torpedo flex hose, ADC.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

The exposure numbers mentioned above are considered conservative, and the Navy anticipates that any potential adverse effects to marine mammals will be further minimized by the implementation of the mitigation measures identified in Chapter 6. In addition, the Navy has concluded that marine mammals will not be impacted by non-acoustic effects. The Navy will request an LOA pursuant to the MMPA, which also requires NMFS to develop the regulations that govern the issuance of an LOA. By issuing the LOA, NMFS would authorize the take of marine mammals incidental to the Navy’s to proceed with the Proposed Action. The Navy is also consulting with NMFS in accordance with Section 7 of the ESA to ensure that USWTR activities would not jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of a critical habitat. This consultation will be complete when NMFS prepares a final BO and issues an incidental take statement.

Therefore, while there is the potential for moderate, recoverable cumulative effects to marine mammals, no significant cumulative impacts are anticipated.

**4.8.6.2.10 Sea Birds**

**USWTR OEIS/EIS Conclusions**

The primary threats to sea birds include commercial fishing and exploitation from hunting sea birds and collecting eggs. Additional considerations include exotic species, marine debris and pollution including underwater sound. The longline fishing industry experiences high incidental catch rates of sea birds because the operations use baited hooks on a main line that remain in the air or near the surface of the water (NMFS, 2001b). The bait attracts birds, which may accidentally get hooked and then drown or entangle as they are dragged underwater. Additionally, personnel on vessels discard fish, scraps, and bait. The availability of these food sources attracts sea birds and in turn, the individuals get hooked or entangled in the main lines (NMFS, 2001b). The majority of research in this area has been conducted in the Pacific because of the concentration of longline operations in Hawaii and Alaska. The Final U.S. National Plan of Action for Reducing the Incidental Catch of Seabirds in Longline Fisheries addresses Atlantic
operations including Atlantic tuna, swordfish, sharks, and billfish (NMFS, 2001b). Historically, NMFS observer programs have focused on sea turtles and marine mammals and have only limited data on sea bird by-catch (NMFS, 2001b). Quantitative information is not currently available on the incidental catch of seabirds in fisheries of the U.S. Atlantic coast.

A number of mitigation measures are under development and have been implemented voluntarily. Such measures include the use of bird-scaring devices and weighted lines, the practice of night setting, and the avoidance of offal (e.g., discarded bait and fish scraps) dumping. Other practices include education and outreach to fishermen and the public and continued research to assess sea bird interactions and appropriate mitigations (NMFS, 2001b).

There is no scientific evidence to suggest birds can hear sounds underwater. Moreover, studies researching the potential effects of underwater sound to diving birds during seismic surveys determined that airguns did not cause harm (Turnpenny and Nedwell, 1994). Furthermore, seabirds spend a short period of time underwater, and it is extremely unlikely that the timing of active sonar use would coincide with the dive of a seabird. Therefore, it was determined that there will be no significant impacts to seabirds from active sonar activities.

In addition, entanglement and the actual drowning of a seabird in a parachute assembly is unlikely, since the parachute would have to land directly on the animal, or a diving seabird would have to be diving exactly underneath the location of the sinking parachute. The potential for a seabird to encounter an expended parachute is extremely low, given the generally low probability of a seabird being in the immediate location of deployment. Therefore, it was determined that there will be no adverse effects to seabirds from entanglement associated with active sonar activities.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Other activities previously described in this chapter have the potential to impact sea birds and migratory birds. Since the majority of USWTR active sonar activities are short-term and occur underwater it is expected that only rare, if any, occurrences of an interaction between active sonar activity and diving seabirds could be expected. As such, there is the potential for minor, but recoverable cumulative impacts to seabirds when combined with other actions. Impacts would be temporary and localized and would not be considered significant.

**4.8.6.2.11 National Marine Sanctuaries**

**USWTR OEIS/EIS Conclusions**

The U.S. Navy does not plan to conduct active sonar activities in the Stellwagen Bank, Monitor, Gray’s Reef, Flower Garden Banks, and Florida Keys National Marine Sanctuaries, avoiding these sanctuaries by selecting range locations away from these Sanctuaries.
USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

The Navy concludes that USWTR active sonar activities would not significantly impact any NMS in the operating areas and are not likely to destroy or cause the loss of resources related to the marine sanctuary. Therefore, it is determined that there is no potential for cumulative effects to NMS.

4.8.6.2.12 Airspace Management

USWTR OEIS/EIS Conclusions

Training on the USWTR will not result in any change to existing airspace configuration and scheduling of airspace. Notices to Airmen (NOTAMs) may be issued prior to the activity to ensure aircraft and pilot safety. Therefore, it was determined that there will be no effect to airspace management.

USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

USWTR active sonar activities will occur in special use Warning Areas, which are plotted on aeronautical charts so all pilots are aware of their location and the potential for military flight training in the respective airspace.

The airspace between and adjacent to the Warning Areas is designated as an Air Traffic Control Assigned Airspace (ATCAA). The Federal Aviation Administration (FAA) ARTCC’s are responsible for air traffic flow control or management within this airspace transition. There are currently 22 ARTCCs in the United States (FAA, 2007). ARTCCs are located in Florida (FAA, 2007). As stated previously, there will be no changes to existing airspace configuration or the scheduling of airspace as a result of USWTR training activities. The Fleet Air Control Surveillance Facility (FACSFAC) is responsible for scheduling, monitoring, and controlling air traffic for the airspace within the Warning Areas. FACSFAC Pensacola is responsible for coordinating naval airspace and requests by the 46th Test Wing at Eglin AFB, Florida.

A NOTAM may be issued prior to USWTR training that involves aircraft maneuvers associated with active sonar activities and sonobuoy drops, as well as flights of helicopters using dipping sonar. The issuance of NOTAMs ensures aircraft and pilot safety. Furthermore, the proper coordination and scheduling with the FAA and respective FACSFAC on all matters affecting airspace significantly reduces or eliminates the possibility of indirect or cumulative impacts on civilian and other military aviation and airspace use. No cumulative impacts to airspace management are anticipated.
4.8.6.2.13 Energy (Water, Wind, Oil and Gas)

**USWTR OEIS/EIS Conclusions**

There are currently no active gas, oil or mineral exploration; or wind farm sites along the East Coast. However, there are proposals which have been filed with federal regulators as discussed in Subchapter 4.8.4.3 involving offshore wind energy and ocean current energy along the East Coast. Based on the discussion, earlier in this subchapter, on these specific alternative energy proposals and oil and gas exploration, there will be no effect to water energy development, wind farms, or gas and oil exploration from active sonar activities off the southeastern or northeastern United States.

There are no predicted effects to current oil and gas drilling platforms during USTWR use and installation. However, any planned energy projects would not be compatible with USWTR if they occurred in the same area.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

The only potential for incremental cumulative impacts is to gas and oil exploration in the Gulf of Mexico. Since USWTR training activities will not be conducted in the Gulf of Mexico, no cumulative impacts are predicted.

4.8.6.2.14 Commercial Shipping

**USWTR OEIS/EIS Conclusions**

Potential effects to commercial shipping vessels would most likely come from interactions or delays associated with military vessels along the shipping routes. Shipping routes exist throughout the nearshore and offshore waters of the OPAREAs. However, the ocean area for active sonar activities by the Navy is significantly larger than the area encompassed by shipping routes. Moreover, there have been no documented significant effects to commercial shipping from previous active sonar activities, and the Navy will avoid shipping vessels that transit through the USWTR site. Therefore, there is a very low probability of an interaction. As presented in the Chapter 4 analysis, there would be no significant impacts to commercial shipping.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Due to the fact that vessel transits associated with active sonar activities would be very short in duration, interaction with commercial shipping vessels is unlikely. Cumulative impacts due to the implementation of training on the USWTR with other activities described in this chapter would most likely minor, temporary and localized. Therefore, the proposed action will not result in any significant incremental cumulative impacts with regard to commercial shipping.
4.8.6.2.15 Commercial and Recreational Fishing

USWTR OEIS/EIS Conclusions

Potential effects to commercial and recreational fishing would most likely come from interactions with military vessels. However, the majority of commercial fish landings by weight and by value in the southeastern and northeastern Atlantic coast occur in state waters, which is also the primary location for recreational fishing activities. The Navy does not routinely close areas off to the public, nor would the Navy conduct active sonar activities within the vicinity of fishing vessels. Therefore, there is a very low probability of an interaction. As presented in the Subchapter 4.4 analysis, there would be no significant impacts to commercial and recreational fishing.

USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Due to the fact that active sonar activities would be very short in duration and interaction with commercial and recreational fishing vessels is unlikely, cumulative impacts due to the implementation of training on the USWTR with other activities described in this chapter would most likely be minor, temporary, and localized. Therefore, the proposed action will not result in any significant incremental cumulative impacts with regard to commercial and recreational fishing.

4.8.6.2.16 Recreational Boating

USWTR OEIS/EIS Conclusions

Potential effects to recreational boating would most likely come from interactions with military vessels. However, most military actions would occur during weekdays, whereas most recreational boating occurs during the weekend. In addition, the Navy does not routinely close areas off to the public, nor would the Navy conduct active sonar activities in the vicinity of recreational boats. Therefore, there is a very low probability of an interaction. As such, as presented in the Chapter 4.4.8 analysis, there would be no effects to recreational boating.

USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Due to the fact that the activities would be very short in duration and interaction with recreational boaters is unlikely, cumulative impacts due to the implementation of the training on the USWTR with other activities described in this subchapter would be minor and short term. No significant cumulative impacts to recreational boating would occur.
4.6.8.2.17 Scuba Diving

**USWTR OEIS/EIS Conclusions**

Recreational diving activities typically occur at known diving sites. The Professional Association of Diving Instructors (PADI) recommends that certified scuba divers limit their dive depths to 12 m (40 ft), and certified open-water divers limit their dives to 18 m (60 ft). While more experienced divers are generally limited to 30 m (100 ft), in general, no recreational diver should exceed 40 m (130 ft) (PADI, 2006). Therefore, the likelihood of affecting divers will decrease inversely in proportion to water depth. With the exception of MIW Independent ULT, Object Detection/Navigational Sonar ULT, and RDT&E activities, all active sonar activities occur in water depths greater than 30 m (100 ft). Moreover, the active sonar activities conducted in water depths less than 30 m (100 ft) would be very short duration, generally lasting from 1 to 6 hours. As such, as presented in the Chapter 4 analysis, there would be no significant effects to scuba diving.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Due to the fact that the activities would be very short in duration, cumulative impacts associated with the implementation of any alternative along with military activities described in this chapter would be minor, temporary, and localized. Therefore, the proposed action will not result in any significant incremental cumulative impacts with regard to recreational diving.

4.8.6.2.18 Whale- and Dolphin-Watching

**USWTR OEIS/EIS Conclusions**

Potential effects to marine mammal watching would come from the closure of areas for military operations. However, marine mammal watching occurs within a few miles of shore and rarely in federal waters. Tours in the southeast typically last from one to two hours in such hotspots for dolphin watching as the Virginia Beach, Virginia; Nags Head, North Carolina; and Hilton Head Island, South Carolina. Tours in the northeast typically range from three to six hours in length, with an average duration of three and one-half to four hours (Whale and Dolphin Conservation Society [WDCS], 2007). Given the short duration of marine mammal excursions and the fact that most trips occur close to shore, the potential for effects to the industry will be low. As such, it was determined in the Chapter 4 analyses that there would be no significant effect to marine mammal watching.

**USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)**

Due to the fact that the activities would be very short in duration, cumulative impacts associated with training on the USWTR, along with military activities described in this chapter would be
minor and temporary. Therefore, the proposed action will not result in any significant incremental cumulative impacts with regard to marine mammal watching.

4.8.6.2.19 Cultural Resources at Sea

USWTR OEIS/EIS Conclusions

As stated in Subchapter 4.5, known shipwrecks are located within and adjacent to the USWTR site. Potential effects to cultural resources at sea would come from physical disturbance, but as stated previously, the small size and low density of expended materials will not cause effects to shipwrecks. Many details, including latitudes and longitudes of submerged wrecks and obstruction in coastal waters of the United States are cataloged in the Automated Wreck and Obstruction Information System. The Navy will avoid all known cultural resources and would consult with the applicable agencies, including the State Historic Preservation Officer if effects to cultural resources are anticipated, as required by law. Therefore, it was determined that there will be no significant effects to cultural resources from training on the USWTR.

USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Most past, present, and reasonably foreseeable future ocean activities such as commercial ship traffic, fishing, energy exploration, or scientific research, would not substantially affect underwater cultural resources. This is most likely due to lack of physical contact with shipwrecks since their locations are cataloged. Moreover, any activities with the potential for significant impacts on cultural resources will require Section 106 consultation, and would be mitigated as required by law. Where avoidance was practiced, no cumulative impact would result since there would be no contact with the cultural resource. Where cultural resources could not be avoided, Section 106 consultation would mitigate any potential adverse affects to the cultural resources. Therefore, there is the potential for minor, but recoverable cumulative impacts to cultural resources from training on the USWTR.

4.8.6.2.20 Environmental Justice

USWTR OEIS/EIS Conclusions

As discussed previously, the installation of the trunk cable and the construction of the cable termination facility would take place on the Naval Station Mayport property. As such, construction and use of the USWTR would not pose disproportionate high or adverse effects to minority or low-income populations, or environmental health and safety risks to children.
USWTR Incremental Contribution and Cumulative Effects from Other Projects and Activities (Past, Present, and Reasonably Foreseeable Future)

Since the construction and use of the USWTR would not pose disproportionate high or adverse effects to minority or low-income populations, or environmental health and safety risks to children, the proposed action will not result in any cumulative impacts.
4.9 Summary of Impacts Relative to the Proposed Action

A summary of the environmental impacts for each USWTR action alternative is presented in Table 4.9-1.
## Table 4.9-1
Summary of Environmental Impacts

<table>
<thead>
<tr>
<th>Environmental Resources</th>
<th>Site A</th>
<th>Site B</th>
<th>Site C</th>
<th>Site D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology, Bathymetry and Substrate, and Water Quality</td>
<td>There would be no significant impact or significant harm.</td>
<td>There would be no significant impact or significant harm.</td>
<td>There would be no significant impact or significant harm.</td>
<td>There would be no significant impact or significant harm.</td>
</tr>
<tr>
<td>Plankton and Benthos</td>
<td>The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.</td>
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<tr>
<td>Fish</td>
<td>There would be no significant impact or significant harm to fish.</td>
<td>There would be no significant impact or significant harm to fish.</td>
<td>There would be no significant impact or significant harm to fish.</td>
<td>There would be no significant impact or significant harm to fish.</td>
</tr>
<tr>
<td>Essential Fish Habitat</td>
<td>Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH.</td>
<td>Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH.</td>
<td>Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH.</td>
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</tr>
</tbody>
</table>

The Navy would consult with NMFS to avoid / reduce impacts.

Potential significant impact to biogenic reef EFH if *Lophelia* Reefs are impacted.

The Navy would consult with NMFS to avoid / reduce impacts.

Potential significant impact to biogenic reef EFH if *Lophelia* Reefs are impacted. The Navy would consult with NMFS to avoid / reduce impacts.
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Acoustic Environmental Impacts</strong> Cont’d</td>
<td><strong>Sea Turtles and Marine Mammals</strong> In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from range activities. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters.</td>
<td>In accordance with NEPA, there would be no significant impact to marine mammals or sea turtles in territorial waters from range activities. In accordance with EO 12114, there would be no significant harm to marine mammals or sea turtles in non-territorial waters.</td>
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</tr>
<tr>
<td><strong>Seabirds and Migratory Birds</strong></td>
<td>No significant impact to seabirds or migratory birds would occur.</td>
<td>No significant impact to seabirds or migratory birds would occur.</td>
<td>No significant impact to seabirds or migratory birds would occur.</td>
<td>No significant impact to seabirds or migratory birds would occur.</td>
</tr>
<tr>
<td><strong>Endangered and Threatened Species</strong></td>
<td><strong>Species</strong> There may be an effect to ESA-listed species. The Navy is consulting with the NMFS to avoid / reduce impacts.</td>
<td><strong>Species</strong> There may be an effect to ESA-listed species. The Navy would consult with the NMFS to avoid / reduce impacts.</td>
<td><strong>Species</strong> There may be an effect to ESA-listed species. The Navy would consult with the NMFS to avoid / reduce impacts.</td>
<td><strong>Species</strong> There may be an effect to ESA-listed species. The Navy would consult with the NMFS to avoid / reduce impacts.</td>
</tr>
<tr>
<td><strong>Critical Habitat</strong> To avoid / reduce potential impacts on North Atlantic right whale critical habitat, the Navy would consult with the NMFS and comply with ESA.</td>
<td><strong>Critical Habitat</strong> No designated critical habitats occur within the range.</td>
<td><strong>Critical Habitat</strong> No designated critical habitats occur within the range.</td>
<td><strong>Critical Habitat</strong> No designated critical habitats occur within the range.</td>
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<tr>
<td><strong>Acoustic Environmental Impacts</strong></td>
<td></td>
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<tr>
<td></td>
<td>However, based on best available science, the Navy concludes that exposures to marine mammals would result in short-term effects to individuals exposed and would likely not affect annual rates of recruitment or survival.</td>
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</tr>
<tr>
<td><strong>Fish</strong></td>
<td>There would be no significant impact to fish populations.</td>
<td>There would be no significant impact to fish populations.</td>
<td>There would be no significant impact to fish populations.</td>
<td>There would be no significant impact to fish populations.</td>
</tr>
<tr>
<td><strong>Scuba Diving</strong></td>
<td>Following Navy operating procedures, no impacts to divers would occur.</td>
<td>Following Navy operating procedures, no impacts to divers would occur.</td>
<td>Following Navy operating procedures, no impacts to divers would occur.</td>
<td>Following Navy operating procedures, no impacts to divers would occur.</td>
</tr>
<tr>
<td><strong>Socioeconomics</strong></td>
<td>There would be no significant impact.</td>
<td>There would be no significant impact.</td>
<td>There would be no significant impact.</td>
<td>There would be no significant impact.</td>
</tr>
<tr>
<td><strong>Cultural Resources</strong></td>
<td>There would be no significant impact.</td>
<td>There would be no significant impact.</td>
<td>There would be no significant impact.</td>
<td>There would be no significant impact.</td>
</tr>
<tr>
<td><strong>Landside Resources</strong></td>
<td>There would be no significant impact. Prior to installation</td>
<td>There would be no significant impact. Prior to installation</td>
<td>There would be no significant impact. Prior to installation</td>
<td>There would be no significant impact. Prior to installation</td>
</tr>
</tbody>
</table>
### Table 4.9-1

Summary of Environmental Impacts

<table>
<thead>
<tr>
<th>Environmental Resources</th>
<th>Site A</th>
<th>Site B</th>
<th>Site C</th>
<th>Site D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/mitigation measures.</td>
<td>of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/mitigation measures.</td>
<td>of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/mitigation measures.</td>
<td>of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/mitigation measures.</td>
</tr>
<tr>
<td>Coastal Zone Management</td>
<td>The proposed action is consistent to the maximum extent practicable with the enforceable policies of the Florida coastal zone management program.</td>
<td>The proposed action is consistent to the maximum extent practicable with the enforceable policies of the South Carolina coastal zone management program.</td>
<td>The proposed action is consistent to the maximum extent practicable with the enforceable policies of the North Carolina coastal zone management program.</td>
<td>The proposed action is consistent to the maximum extent practicable with the enforceable policies of the Virginia coastal zone management program.</td>
</tr>
</tbody>
</table>
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