Final Overseas Environmental Impact Statement/ Environmental Impact Statement

UNDERSEA WARFARE TRAINING RANGE

Volume I

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Department of the Navy

Action Proponent:
United States Fleet Forces Command

Cooperating Agency:
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Abstract: This final overseas environmental impact statement/environmental impact statement has been prepared by the Department of the Navy to address the impacts of the installation and operation of the proposed undersea warfare training range. The potentially affected areas of the preferred site (in the Jacksonville Operating Area) and of the alternative sites (within the Charleston, Cherry Point, and Virginia Capes Operating Areas) have been studied to determine how installation of and operation on the proposed undersea warfare training range would affect the marine and landside environments.

EXECUTIVE SUMMARY

The proposed action is to place undersea cables and transducer nodes in a 1,713-square-kilometer (km^2) (500-square-nautical-mile [NM^2]) area of the ocean to create an undersea warfare training range (USWTR) for anti-submarine warfare (ASW) training. The ASW training would involve up to three vessels and two aircraft using the range for any one training event, although events would typically involve fewer units. The instrumented area would be connected to the shore via a single trunk cable. The proposed action would require logistical support for ASW training, including the handling (launch and recovery) of exercise torpedoes (non-explosive) and submarine target simulators.

ES.1 Purpose of the Proposed Action

The purpose of the proposed action is to enable the U.S. Navy to train effectively in a shallow water environment (37 to 274 meters [m], or 120 to 900 feet [ft], in depth) at a suitable location for Atlantic Fleet ASW capable units. The 37-to-274-m (120-to-900-ft) depth parameter for the range was derived from collectively assessing depth requirements of the platforms that would be using this range, and approximate the water depth of potential areas of conflict that the Navy has identified.

ES.2 Need for the Proposed Action

There are four fundamental reasons why the Department of the Navy (DoN) requires an instrumented undersea warfare training range off the east coast of the U.S.:

- **Worldwide Deployment Involving Littoral Conditions.** Atlantic Fleet units deploy worldwide, and shifts in the military strategic landscape require increased naval capability in the world's shallow, or littoral, seas; such as the Arabian Sea, the South China Sea, and the Korean Sea. Training effectively for these shallow littoral environments requires the availability of realistic conditions in which potential combat situations can be adequately simulated.

- **U.S. World Role**. The role of the U.S. in keeping critical sea lanes open makes it imperative that U.S. military forces be the best trained, prepared, and equipped in the world. ASW is a Navy core capability and is a critical part of that mission. The Navy is the only Department of Defense (DoD) service with an ASW responsibility, and must be trained and capable in littoral water operations to assure access for the U.S. and our allies to strategic areas worldwide.

- **Threat of Modern Diesel Submarines**. The current global proliferation of extremely quiet submarines poses a critical threat to the maritime interests of the

U.S. These silent diesel submarines, easily obtainable by potential adversaries, are capable of extended, silent, submerged operations in confined, congested littoral regions where acoustic conditions make detection significantly more challenging than in deep water. These silent vessels can get well within ‘smart’ (i.e., self-guided) torpedo or anti-ship missile range of U.S. forces before there is a likelihood of their being detected by passive sonar “listening.” For this reason, use of, and training with, active sonar is crucial to today’s ASW, U.S. operational readiness, national defense, and homeland security. Such training is critical to our ability to deliver fighting forces overseas and to protect civilians and cargo in transit on the world’s oceans.

- **Mission Readiness and Fulfillment**. The Navy's primary mission is to maintain, train, equip, and operate combat-ready naval forces capable of resolving conflicts, deterring aggression, and maintaining freedom of the seas. Training with the actual sensors and weapons systems aboard their own ship, submarine, or aircraft, in a complex and appropriate operational setting, and with a realistic scenario is key to maintaining Fleet combat readiness and to survival in actual wartime conditions.

  Timely and accurate feedback of training performance to exercise participants and the ability to rapidly reconstruct the training event contribute significantly to the quality of this complex training. These capabilities may only be realized through the use of an instrumented, at-sea training range. At present, the only operational Atlantic instrumented training range is located in a deep-water environment, requiring that results be extrapolated to apply to the critically different conditions of shallow water. Doing so requires speculation and interpretation to evaluate crew and equipment performance, reducing the accuracy of the feedback.

  The proposed USWTR would provide an environment:

  - that is consistent with real-world threat situations.
  - where training exercises can be conducted under safe and controlled conditions.
  - with critically important real-time feedback that eliminates the need to repeat training events to validate and confirm results.

In addition, Section 5062 of Title 10 of the U.S. Code (USC) contains a legal mandate for such training as would be provided by the proposed range. Title 10 directs the Chief of Naval Operations (CNO) to organize, train, and equip all naval forces for combat. The CNO fulfills this direction by conducting training activities prior to deployment for actual operations.

ES.3 Preparation of the Final Overseas Environmental Impact Statement/Environmental Impact Statement (Final OEIS/EIS)

The DoN has prepared this final overseas environmental impact statement/environmental impact statement (OEIS/EIS) to assess the potential environmental effects of installing and operating a USWTR offshore of the east coast of the United States. The final OEIS/EIS has been prepared pursuant to:

- National Environmental Policy Act (NEPA) of 1969, which requires a detailed environmental analysis for major federal actions with the potential to significantly affect the quality of the human environment.
- Council on Environmental Quality (CEQ) regulations in 40 Code of Federal Regulations (CFR) Parts 1500 to 1508, which implement the requirements of NEPA.
- Presidential Executive Order (EO) 12114, which requires environmental documentation for *Environmental Effects Abroad of Major Federal Actions*.
- DoD regulations implementing EO 12114: 32 CFR Part 187, *Environmental Effects Abroad of Major Department of Defense Actions*.
- DoN regulations implementing NEPA (32 CFR Part 775).

The provisions of NEPA apply to major federal actions with effects that occur within U.S. territory. *In this final OEIS/EIS, text that describes the effects that occur within U.S. territory is in italicized font.* EO 12114 applies to major federal actions outside the 50 states, territories, and possessions of the U.S., including marine waters seaward of the U.S. territorial seas. The proposed action involves impacts both within and outside U.S. territory; therefore, the document is being prepared as a final OEIS/EIS under the authorities of both NEPA and EO 12114.

In preparation of this final OEIS/EIS, the DoN evaluated alternative sites for the proposed USWTR. Siting of the USWTR offshore of northeastern Florida is the Navy’s preferred alternative.

The National Marine Fisheries Service, a part of the National Oceanic and Atmospheric Administration, is a cooperating agency in the preparation of this final OEIS/EIS.

ES.4 Proposed Action and Alternatives

ES.4.1 Proposed Action

ES.4.1.1 Range Installation

The USWTR instrumentation is a system of underwater acoustic transducer devices, called nodes, connected by cable to each other and to a landside facility where the collected range data are used to evaluate the performance of participants in shallow water training exercises. These transducer nodes are capable of both transmitting and receiving acoustic signals from ships and submarines operating within the USWTR, which allows the position of the participants to be determined and stored electronically for both real-time and future evaluation. More specifically:

- The USWTR would consist of no more than 300 transducer nodes spread on the ocean floor over an area of approximately 1,713-km^2 (500-NM^2). The distance between nodes would vary from 2 to 6 km (1 to 3 NM), depending on water depth.

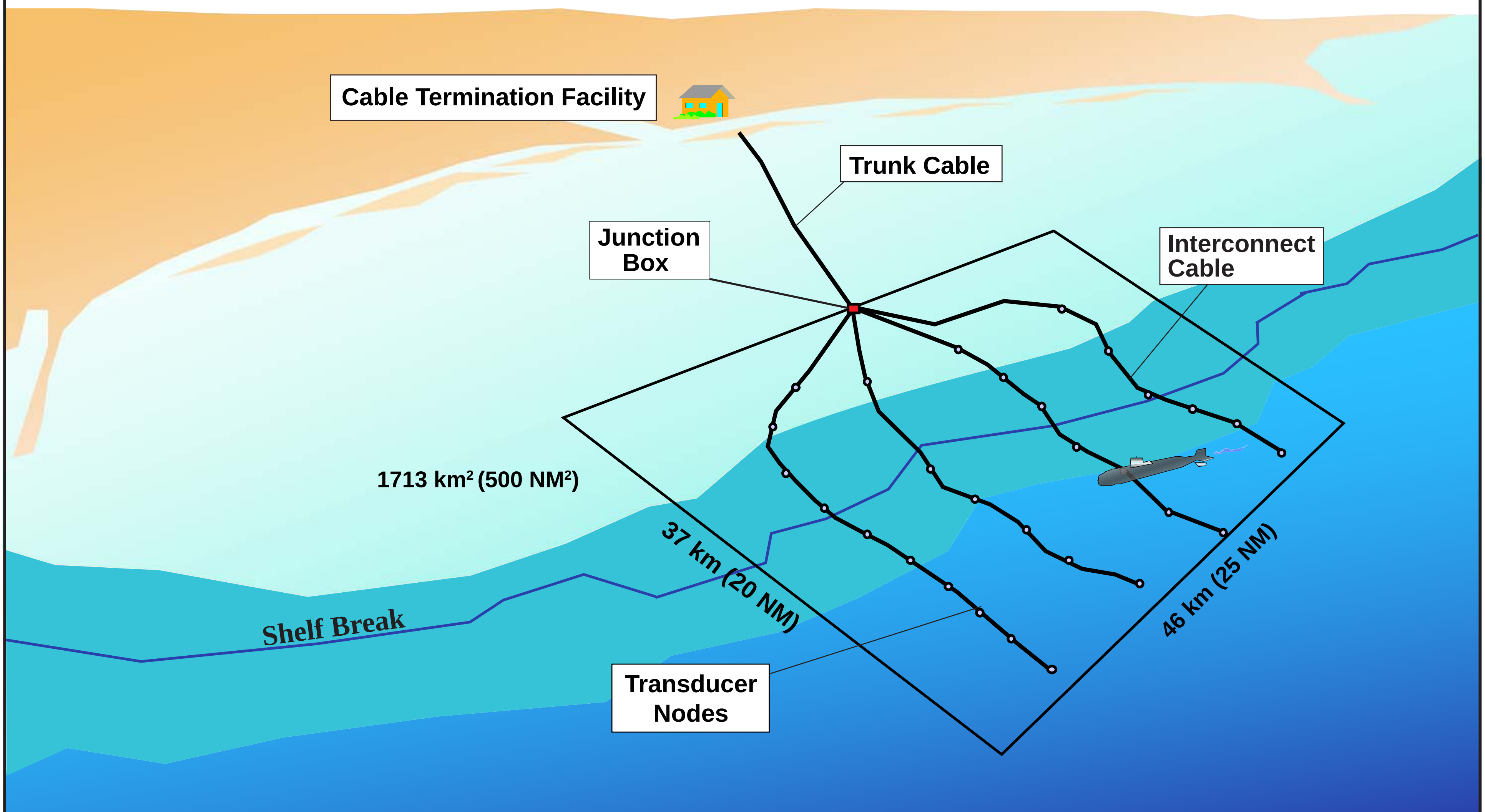
- The nodes would be connected with commercial fiber optic undersea cable approximately 3.1 centimeters (cm) (1.22 inch [in]) in diameter, such as that used by the telecommunications industry. A total of approximately 1,110 km (600 NM) of cable would be used between nodes.

- The interconnect cable between each node would be buried, if deemed necessary, at specific locations within a range. The decision to bury would be based on activities that interact with the bottom, such as anchoring and extensive use of bottom-dragged fishing gear. The trunk cable connecting the range to the shore facilities would be buried to a depth of approximately 1 m (3 ft). The trunk cable would be installed in conduit via horizontal directional drilling nearshore, and by trenching between the land side end of the conduit and further offshore of the end of the conduit to the junction box. Ocean-bottom burial equipment would be used to cut (hard bottom) or plow (soft sediment) a furrow approximately 10 cm (4 in) wide, into which the cable would be placed.

- *The landside portion of the trunk cable would be buried and terminate in a small building, known as the cable termination facility (CTF), an approximately 37-m^2 (400-ft^2) structure that would house the power supplies, system electronics, and communications gear necessary to operate the offshore range. From the CTF, secure data (associated computer equipment rendering relevant array information into digital, comprehensible, event information then encrypting it for further transmission) would be forwarded to FACSFAC Jacksonville (for Site A or B) or FACSFAC VACAPES (for Site C or D) and debriefing sites ashore.*

Figure ES-1 is a general illustration of the USWTR instrumentation on land and in the water.

USWTR Range Concept



Not to Scale

Figure ES-1

Construction would be completed in one to three phases based on the funding profile. If completed in multiple phases, the first phase would be a minimum of 686 km^2 (200 NM^2), followed by another 686 km^2 (200 NM^2) and a final increment of 343 km^2 (100 NM^2). A two phase installation is also possible. Construction would take approximately 6 to 12 months per phase. The OEIS/EIS reflects the anticipated effects of a single installation phase and the entire operational capability of the USWTR.

ES.4.1.2 Training Range Usage

The principal type of exercise conducted on the USWTR would be ASW, for which a wide range of platforms (i.e., ships and aircraft), non-explosive exercise weapons, and training-related devices are used. Submarines, surface ships, and aircraft all conduct ASW and would be the principal users of the range. The requirements of threat realism on the USWTR necessitate training with a variety of sensors, non-explosive exercise weapons, target submarine simulators, and other associated hardware. Many of the materials used on the USWTR would be recovered after use; however, some would be left in place. All ordnance used would be non-explosive.

Either individually or as a coordinated force, submarines, surface ships, and aircraft conduct ASW against submarine targets. Submarine targets include both actual submarines and other mobile targets that simulate the operations of an actual submarine. ASW exercises are complex and highly variable. These exercises have been grouped into the four representative scenarios, summarized in Table ES-1, in order to best characterize them for environmental impact analysis purposes.

ES.4.2 Site Selection Process

Operational requirements for the USWTR site are set forth in what is called an operational requirements document (ORD) (Subchapter 2.3.1.1). The ORD contains both the operational and physical requirements for the USWTR and is the basis for the site selection process. The first step for the Navy in identifying alternative sites for the USWTR was to define the parameters required for an effective range. While the USWTR would be an underwater training range, as it is to be primarily used for ASW, exercises would typically involve surface and air participants as well. The site selection process evaluated operational and climatological factors, including air station proximity, climatological availability, and shore landing site and infrastructure. The sites were ranked in each category as desirable, satisfactory, or unsatisfactory, and then the results of the evaluations for each site were compared. The site selection process for the USWTR narrowed the potential USWTR sites to four: offshore of northeastern Florida (Jacksonville OPAREA); offshore of central South Carolina (Charleston OPAREA); offshore of southeastern North Carolina (Cherry Point Operating Area [OPAREA]); and offshore of northeastern Virginia (VACAPES OPAREA).

Table ES-1

USWTR Scenarios

Component	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Exercise Participants	One fixed- or rotary-wing aircraft vs. one submarine target	One ship and one helicopter vs. submarine target	One submarine vs. one submarine target	Two surface ships and two helicopters vs. submarine target
Exercise Weapons Used (all Weapons are Non-explosive)	Lightweight exercise torpedoes (EXTORPs) and lightweight recoverable exercise torpedoes (REXTORPs)	Lightweight and heavyweight EXTORPs (and once per year, a vertical launch antisubmarine rocket [VLA] may be fired from a ship on range) and REXTORPs	Heavyweight EXTORPs	Lightweight and heavyweight EXTORPs (and once per year, a VLA may be fired from a ship on range) and REXTORPs
Active Sound Sensors/ Sources Used	Active sonobuoys, dipping sonar, range pingers, torpedo sonar, underwater communication devices, submarine acoustic countermeasures, and anti-torpedo decoys (NIXIE)	Ships' sonar, active sonobuoys, range pingers, dipping sonar, torpedo sonar, and underwater communication devices, submarine acoustic countermeasures, and NIXIE	Submarine sonar, range pingers, torpedo sonar, and underwater communication devices	Ships' sonar, active sonobuoys, range pingers, dipping sonar, torpedo sonar, and underwater communication devices, submarine acoustic countermeasures, and NIXIE
Other Devices Used	Passive sonobuoys, target simulators, submarine acoustic countermeasures, and expendable bathythermographs (XBTs)	Passive sonobuoys, target simulators, submarine acoustic countermeasures, and XBTs	Submarine acoustic countermeasures, submarine target simulators, and XBTs	Passive sonobuoys, target simulators, submarine acoustic countermeasures, and XBTs
Approximate Duration of Exercise	2 hours (helicopters) 4 – 5 hours (fixed wing)	3 hours	6 hours	3 hours
Frequency of Exercise	355 exercises per year	62 exercises per year	15 exercises per year	38 exercises per year
Comments	Submarine targets can be an actual submarine or submarine target.	Submarine targets can be an actual submarine or submarine target.	One submarine simulates a quiet diesel-electric submarine. The other attempts to detect, locate, and simulate attack.	Submarine targets can be an actual submarine or submarine target.

Subsequently, because of new operational concerns, revised capabilities, and relocation of Fleet assets that have occurred over the last decade, the Charleston OPAREA located offshore of Charleston, South Carolina, was added as a potential alternative site. Figure ES-2 depicts the general locations of the USWTR sites along the east coast of the United States. The alternative sites are now:

- Site A - offshore of northeastern Florida (Jacksonville OPAREA).
- Site B – offshore of central South Carolina (Charleston OPAREA).
- Site C – offshore of southeastern North Carolina (Cherry Point OPAREA).
- Site D – offshore of northeastern Virginia (VACAPES OPAREA).

Based on application of the site evaluation criteria and proximity to Navy fleet concentration areas, Alternative A, USWTR Site A off the coast of northeastern Florida, is the preferred USWTR site alternative. This alternative offers excellent training opportunities based on bathymetric and typical water column characteristics in the area.

ES.4.3 Description of Alternatives

ES.4.3.1 Alternative A

The western edge of the Site A USWTR would be located 93 km (50 NM) east of Florida's northeastern shoreline. Installation of the USWTR at the proposed Site A, as at all proposed sites, would entail the placement of no more than 300 transducer nodes in water depths ranging from approximately 37 to 366 m (120 to 1,200 ft), over an approximate 1,713-km^2 (500-NM^2) area. The interconnect cable between each node may be buried in the shallower depths at Site A due to potential entanglement concerns related to bottom-trawling fishing gear (there is more intensive bottom trawling in the vicinity of the Sites A and D than in the vicinity of Sites B and C). In deeper waters, the interconnect cable would not be buried. The trunk cable connecting the range to the CTF located on shore would be buried (including within U.S. territory) to a depth of approximately 0.5 to 1 m (1 to 3 ft).

The trunk cable would either be directly buried in an armored cable or conduit on shore at Naval Station (NS) Mayport. Commercial power and telecommunications connections would be made to the Naval Station Mayport infrastructure. The communications signals would be routed to the range operations center (ROC) at Fleet Area Control and Surveillance Facility Jacksonville (FACSFAC JAX) and electronics would be housed at the terminal end of the communications link.

ES.4.3.2 Alternative B

The western edge of the Site B USWTR would be located approximately 70 km (38 NM) offshore of central South Carolina. The interconnect cable between each of the 300 nodes would be buried if deemed necessary. The trunk cable connecting the range to the CTF located on shore would be buried (including within U.S. territory) to a depth of approximately 0.5 to 1 m (1 to 3 ft).

Onshore, Ft. Moultrie on Sullivan's Island provides a possible shore landing site for the cable. The trunk cable would either be directly buried in an armored cable or conduit on shore. Power and telecommunications connections would be made with the Ft. Moultrie National Monument. Data would be sent from the CTF to the ROC at FACSFAC JAX or VACAPES and electronics would be housed at the terminal end of the communications link.

ES.4.3.3 Alternative C

Under this alternative, the western edge of the USWTR would be located about 86 km (47 NM) offshore of southeastern North Carolina. The interconnect cable between each node might be buried. The trunk cable connecting the range to the CTF located on shore would be buried (including within U.S. territory) to a depth of approximately 0.5 to 1 m (1 to 3 ft).

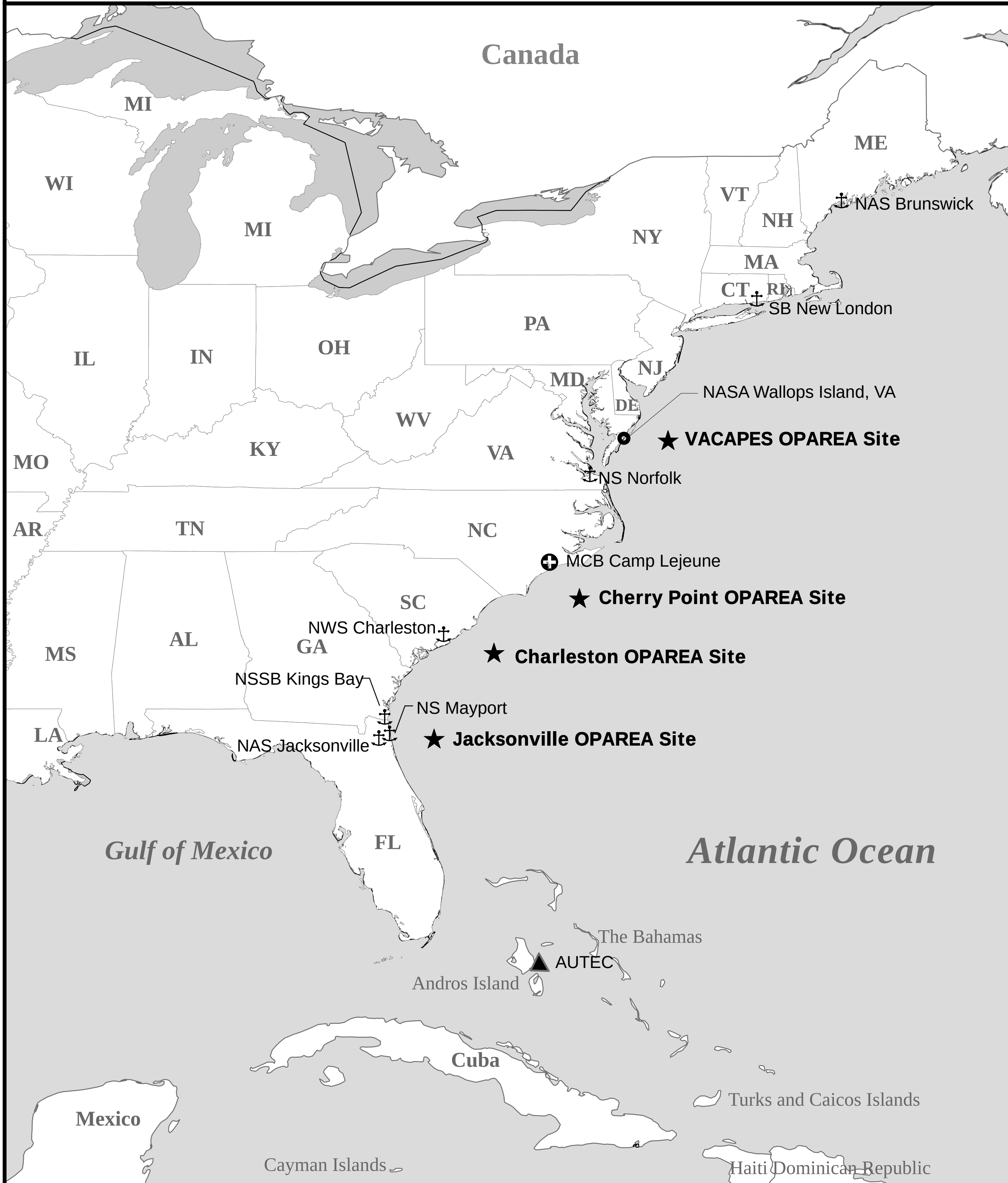
Onshore, the Marine Corps Base Camp Lejeune in Jacksonville, North Carolina, provides a possible shore landing site for the cable. The trunk cable would either be directly buried in an armored cable or conduit on shore. Data would be sent from the CTF to the Starling communication site at MCB Camp Lejeune and then to the ROC at FACSFAC VACAPES, and electronics would be housed at the terminal end of the communications link.

ES.4.3.4 Alternative D

Under Alternative D, the western edge of the USWTR would be located about 63 km (34 NM) east of Virginia's northeastern shoreline. The interconnect cable between each node may be buried in the shallower depths at Site D due to potential entanglement concerns related to bottom-trawling fishing gear. In deeper waters, the interconnect cable would not be buried. The trunk cable connecting the range to the CTF located on shore would be buried (including within U.S. territory) to a depth of approximately 0.5 to 1 m (1 to 3 ft).

The trunk cable would be installed either directly buried in an armored cable or conduit at the National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF). Commercial power and telecommunications connections would be made to the NASA WFF infrastructure. The communications signals would be routed to the ROC at FACSFAC VACAPES, and electronics would be housed at the terminal end of the communications link.

USWTR Alternative Site Locations



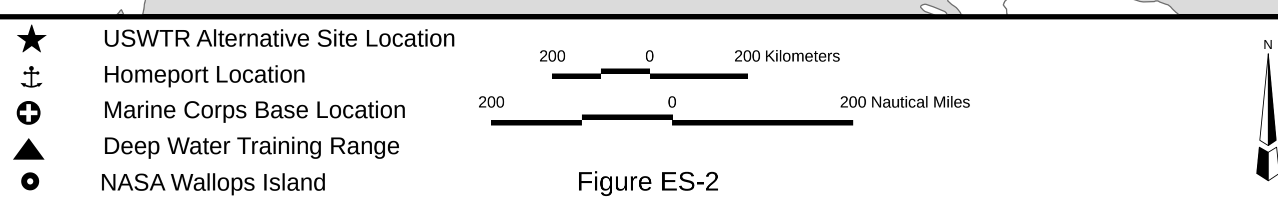


Figure ES-2

ES.4.3.5 No Action Alternative

CEQ regulations provide that a No Action Alternative should be included in the analysis of alternatives and associated impacts. 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, no USWTR would be installed off the east coast of the U.S. However, under the No Action Alternative, active sonar activities would continue across Navy OPAREAs and adjacent areas in a manner that maximizes research, development, testing and evaluation (RDT&E) and training opportunities; and ASW training would continue to take place. Training involves the use of passive and active sonar during simulated attacks on surface ships or submarines. A detailed analysis of current ASW training impacts is contained in the Navy's Final EIS/OEIS for Atlantic Fleet Active Sonar Training.

Although a No Action Alternative would not prevent the Navy from maintaining ASW readiness, the No Action Alternative is detrimental to training efficiency and effectiveness primarily because it lacks timely feedback of performance data to participating units.

ES.5 Impacts of the Proposed Action and Alternatives

ES.5.1 Physical Environment

For each of the alternatives, the cable installation would temporarily displace some bottom sediments and increase local sedimentation rates as the material returned to the sea floor. Installation of the cable and transducer nodes would also result in a temporary increase in turbidity that would not pose a significant impact, given its limited duration.

Materials expended during the launch, operation, and recovery of exercise torpedoes (such as control wires, air launch accessories, flex hose, and ballast), expended devices (expendable bathythermographs [XBTs], sonobuoys, and acoustic device countermeasures [ADCs]), and expendable mobile ASW training targets (EMATTs) would be left in place. The expended materials are unlikely to result either in any significant environmental impacts to the sea floor or in a significant degradation of marine water quality. Over a period of years, these materials would degrade, corrode, and become incorporated into the sediments.

ES.5.2 Acoustic Effects

A screening analysis was conducted to determine whether 1) a given species could occur within the geographic area influenced by the active acoustics on one of the four USWTR sites, and if so, 2) if it possessed some sensory mechanism that would allow it to perceive the sounds generated on the USWTR. Based on this screening analysis, plankton, invertebrates, seabirds, sea turtles, pinnipeds, and manatees were excluded from acoustic effect analysis.

Although it is expected that some fish species would be able to detect the lower frequency sounds to be generated on the USWTR and individual fish may be affected, discernable effects to local fish populations are not anticipated. There is limited information available that suggests that very intense non-impulsive acoustic sources at close ranges could result in mortality to small fish larvae. Experiments have shown that exposure to loud sound can result in significant threshold shifts (reductions in hearing sensitivity) in certain fish that are classified as hearing specialists (but not those classified as hearing generalists), however these threshold shifts are temporary and it is not evident that they lead to any long term effects.

With regard to human divers, it is unlikely that recreational or commercial divers would be present in the USWTR area. However, if divers were present, the potential for effects on them from active sonar transmissions within the USWTR would be negligible, as Navy training exercises would not be conducted close enough to them to exceed permissible exposure limits. 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.

Mysticete (baleen whales) and odontocete (toothed whales) species studied to date hear in the mid- to high-frequency range and may be found at the USWTR sites. Thus, mysticetes and odontocetes are included for further evaluation from an acoustic perspective.

Potential effects are categorized either as physiological effects, which include permanent threshold shift (PTS) and temporary threshold shift (TTS), or behavioral effects. Categorizing potential impacts as either physiological or behavioral effects allows them to be related to the Marine Mammal Protection Act (MMPA) harassment definitions 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. For this OEIS/EIS, the Level A harassment “zone” extends from the source to the distance and exposure at which the slightest amount of injury is predicted to occur (onset PTS).

- 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 behavior patterns…to a point where such behavioral patterns are abandoned or significantly altered.” For this OEIS/EIS, the Level B “zone” begins just beyond the point of slightest injury and extends outward from that point to include all animals that may possibly experience behavioral disturbance (either TTS or behavioral disturbance at levels below TTS).

In this final OEIS/EIS, sound exposure thresholds for TTS and PTS are as presented in the following text box:

195 dB re 1 μPa^2-s received SEL* for TTS

215 dB re 1 μPa^2-s received SEL for PTS

***SEL = sound exposure level

In this final OEIS/EIS, a risk function is used to determine the probability of behavioral disturbance at exposure levels below those that may cause TTS. The function determines the probability of harassment for animals based upon the maximum received sound pressure level (dB re 1 μPa). The function is applied to marine mammal density estimates to determine the proportion of animals that experience behavioral disturbance and which are counted as Level B harassment.

Navy actions on the fixed instrumented range would be repeated in the same geographic area over time. In developing Level B criteria for this document, the Navy conservatively assumed that short-term, non-injurious sound exposure levels (SELs) could result in behavioral pattern disruption in the context of the proposed use of a USWTR. As a result, the actual incidental harassment of marine mammals associated with this action may be less than calculated.

It is important to distinguish the criteria and thresholds proposed for the operation of mid-frequency active sonars at the USWTR from the criteria and thresholds supporting the MMPA letters of authorization issued by the National Marine Fisheries Service (NMFS) for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar. There are fundamental differences between the sound sources that will operate at USWTR and the SURTASS LFA system. The criteria used in this analysis account for the characteristics associated with operation of active mid-frequency sonars. The Navy issued the Record of Decision for Atlantic Fleet Active Sonar Training (AFAST). This project includes 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 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.

ES.5.3.1 Endangered Species

Sound exposure zones were developed based on the impact criteria and thresholds described above. These criteria are also applied to evaluate the potential for harm (injury) or harassment under the Endangered Species Act (ESA). The Navy concludes that the use of the proposed USWTR has the potential to affect certain endangered marine mammals, and consultation with NMFS, in accordance with ESA, is appropriate for this action. The Navy's assessment indicates that the proposed action will not adversely modify or destroy any critical habitats.

The ESA-listed sea turtle species that could occur in each of the four alternative USWTRs are: leatherback turtle; loggerhead turtle, green turtle; Kemp's ridley turtle; and, hawksbill turtle. There could be an incidental take of these species as a result of vessel operations during cable installation and during training exercises on the range.

The ESA-listed marine mammal incidental exposure estimates for the proposed Site A USWTR include the North Atlantic right whale and the humpback whale. The ESA-listed marine mammal incidental exposure estimates for the proposed Site B USWTR include the North Atlantic right whale and the humpback whale. The ESA-listed marine mammal incidental exposure estimates for the proposed Site C USWTR include the North Atlantic right whale. The ESA-listed marine mammal incidental exposure estimates for the proposed Site D USWTR include the North Atlantic right whale, the fin whale, and the sperm whale. Although the effects of the short-term sound exposures are not expected to be significant, the Navy concludes that activities on the range may affect these species and will discuss mitigation measures with NMFS during the ESA consultation process.

ES.5.3.2 Marine Mammal Protection Act

The Navy concludes that impacts to species or stocks of marine mammals would be negligible for each of the proposed USWTR alternatives. Species that may be harassed as a result of range installation and use are listed in Table ES-2.

- The overwhelming majority of the acoustic exposures are within the *non-injurious* TTS or behavioral effects zones.
- Species-specific analyses support the conclusion that proposed USWTR installation and operations would have a negligible impact on species or stocks of marine mammals at any of the USWTR alternative sites.

Table ES-2

Non-ESA-Listed Species of Marine Mammals Evaluated for Incidental Harassment

Species	Site A	Site B	Site C	Site D
Minke Whales	√	√	√	√
Pygmy/dwarf Sperm Whales	√	√	√	√
Beaked Whales*	√	√	√	√
Atlantic White-sided Dolphin				√+
Rough-toothed Dolphin	√	√	√	√
Bottlenose Dolphin	√	√	√	√
Pantropical Spotted Dolphin	√	√	√	√
Atlantic Spotted Dolphin	√	√	√	√
Striped Dolphin	√	√	√	√
Clymene Dolphin	√	√	√	√
Common Dolphin	√	√	√	√
Risso's Dolphin	√	√	√	√
Pilot Whales	√	√	√	√
Harbor Porpoise			√+	√+

Note:
* Beaked whale species here are assumed to include Gervais', Blainville's, True's, and Cuvier's beaked whales.
+ Insufficient data exists to calculate density estimates for these species in the indicated OPAREA; however, rare observations have been made indicating that these species may be present in the OPAREA.

The Navy will submit an MMPA Letter of Authorization (LOA) request for the preferred alternative. As part of that process, the Navy will consult with NMFS on potential mitigation measures and their potential to reduce the likelihood for behavioral disturbance and incidental harassment of marine mammals. Harassment estimates for this final OEIS/EIS are primarily *without* consideration of mitigation measures.

ES.5.3 Non-Acoustic Effects

ES.5.3.1 Ecology

The potential non-acoustic effects on marine organisms at the proposed USWTR sites are discussed together, since impacts are anticipated to be similar at the four sites.

Cable installation may have a temporary impact on benthic organisms, including benthic fish, during the placement of the transducer nodes and interconnect cable and the burial of the trunk cable. As this action would result in a reduction of the quantity and/or quality of some types of essential fish habitat (EFH), installation of the proposed USWTR may adversely affect EFH at all of the four proposed sites. By letter dated October 16, 2008, the Navy submitted the Biological Assessment to the Office of Protected Resources of NMFS. The Biological Assessment provided an assessment of the potential impacts to species listed under ESA.

Marine mammals are not likely to be impacted during construction, as they do not typically utilize sea floor habitat for extended periods of time. Green, loggerhead, and Kemp's ridley sea turtles are associated with ocean bottom habitats. The construction period for installing cable is of limited duration; thus, there would be an extremely low probability that installation equipment would come into direct contact with any turtle. The Navy concludes that the placement and burial of cable may affect sea turtle species, all of which are protected under the Endangered Species Act (ESA). Further, placement and burial of cable may affect ESA-listed mammal species.

No ordnance would be detonated during training exercises; therefore, the physical force to which marine organisms would be exposed would be limited to that produced by torpedo launching and movement. There is negligible risk that a marine mammal could be struck by a torpedo during ASW training events on the USWTR sites. There would be no adverse effects to marine organisms with respect to chemical releases from sensing devices, countermeasures, and targets. The Navy determined that the deployment of materials such as torpedo control wires, air launch accessories, flex hoses, and EMATTS on the proposed USWTR range may affect ESA-listed species or harass or take species protected under the MMPA. Therefore, the Navy concludes that the construction of the proposed USWTR has the potential to affect certain listed sea turtle species, and consultation with NMFS, in accordance with ESA and MMPA, is appropriate for this action.

With respect to potential vessel strikes, the Navy has adopted protective measures to reduce the potential for collisions with surfaced marine mammals and sea turtles. Based on these standard operating procedures, collisions with marine mammals and sea turtles are not expected. In addition, the Navy has adopted protective measures for North Atlantic right whales during transit of Navy vessels in near-shore areas of the mid-Atlantic. Based on the Navy protective measures and the implementation of mitigation measures during times of anticipated right whale occurrence, Navy vessels are not likely to adversely affect North Atlantic right whales.

ES.5.3.2 Socioeconomic Environment

Socioeconomic impacts on military usage, commercial fishing, recreational fishing, shipping, and commercial and recreational boating were examined.

The general areas of sites A, B, C, and D are all major areas of military use, primarily by the Navy and Marines. FACSFAC VACAPES would centrally coordinate USWTR utilization to avoid conflicts with military operations in either the Cherry Point or VACAPES OPAREA, whereas FACSFAC JAX would coordinate USWTR utilization related to the Jacksonville

OPAREA and Charleston OPAREA. Therefore, none of the four proposed USWTR sites would have significant negative effects on military activity in the vicinity of the ranges.

It is anticipated that there would be little potential interaction between the trunk cable and fishing gear, including bottom equipment. While recreational fishing is popular in each of the OPAREAs, most recreational fishing and boating occurs within a few miles of shore and is expected to be infrequent in the vicinity of any of the proposed USWTR sites. A delay or immediate hold on exercises would be considered if any vessel or aircraft entered the vicinity of the exercise.

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 is in the exclusive economic zone, no disruption to commercial shipping could be imposed. Commercial ship traffic or recreational boating activities within the operations area could require that the Navy delay, interrupt, or alter training exercises.

ES.5.3.3 Cultural Resources at Sea

Shipwrecks and/or obstructions are known to occur within the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAS. Known shipwreck locations would be avoided during installation. If a shipwreck were identified during the survey of the trunk cable corridor or within the range boundaries, its location would be documented so that it could be avoided in the placement of the nodes and the cables. If a shipwreck is found, the Navy would consult with the State Historic Preservation Office pursuant to Section 106 of the National Historic Preservation Act. It is unlikely that materials expended during the proposed USWTR exercises would come into contact with the shipwrecks and adversely affect them.

ES.5.3.4 Landside Impacts

Potential landside impacts were considered for each proposed USWTR site, as follows:

- ***Land use**: There would be no land use impacts at the proposed USWTR landfall sites. Operation of the CTF would be consistent with the ongoing uses of each site.*
- ***Socioeconomics:** There would be no displacement of persons associated with implementation of landside components of the proposed action at each site. With respect to the executive order (EO) on environmental justice (EO 12898), implementation of the proposed action at any USWTR site would not result in disproportionately high and adverse environmental or health impacts on minority or low-income populations. In regard to EO 13045, implementation of the*

proposed action at any of the proposed sites would not pose disproportionate environmental health and safety risks to children.

- ***Wetlands****: At each of the proposed USWTR landfall sites, the CTF would be sited to avoid any wetland areas. While installing the landside portion of the trunk cable, if wetlands occur in the proposed route of the trunk cable, directional drilling would be used to avoid wetlands to the maximum extent practicable.*

- ***Threatened and endangered species****: At the proposed Site A landfall location, the construction and operation of the USWTR would have no effect on the wood storks observed near NS Mayport, as there are no documented nests in the immediate vicinity of the CTF. With respect to sea turtles, current conservation measures in place at NS Mayport beach would result in no effect to any nesting sea turtles that may occur. Manatees would not be affected.*

  With respect to the Site B landfall location, federally threatened loggerhead sea turtles nest on Sullivan's Island. In nearshore waters, the Florida manatee has been sighted near Charleston Harbor. Conservation measures would be implemented so that there would be no effect to these species. There have been no surveys conducted for seabeach amaranth, Canby's dropwort, or American chaffseed, so their presence in the vicinity of Fort Moultrie National Monument is not known. 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 United States Fish and Wildlife Service (USFWS) if any threatened or endangered species are found.

  At the proposed Site C landfall location, conservation measures are already in place to protect the seabeach amaranth, piping plover, and sea turtles that may nest on the beach. Adherence to the conservation measures currently in place would minimize or eliminate the potential for adverse effects on all three species.

  The landfall location at Site D, Wallops Island, 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, so no effects are anticipated.

- ***Essential fish habitat****: 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 CTF at NS Mayport, Fort Moultrie, Onslow Beach, or Wallops Island. The maximum area potentially impacted in the process of burying the trunk cable is estimated as a 5-m (16.4-ft) wide path.*

- ***Migratory birds****: Although migratory birds utilize beach habitats as foraging habitat, the construction and operation of the USWTR at the landside sites 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.*

- ***Vegetation and soils:*** *Minimal clearing of existing maritime scrub/shrub vegetation would be required at each proposed site. While there would be short-term impacts such as the disturbance of soil and vegetation during the construction phase, all areas would be returned to pre-disturbance grade and stabilized; thus, there would be no long-term impacts to soils or vegetation in the affected area at each of the proposed USWTR landfall sites.*

- ***Floodplain management****: Installation of the proposed USWTR landside facilities at the proposed USWTR sites at NS Mayport, Fort Moultrie, Onslow Bay, and Wallops Island would require construction within the floodplain (From the CTF, the trunk cable would be buried in an excavated trench to a point just upland of either sand dunes or an impassable physical feature [such as a highway]. The trunk cable would then run through an underground conduit, which would be installed by horizontal directional drilling. The conduit would extend from the end of the trench, underneath the dunes, beach, and shoreline; to a point approximately 915 m [3,000 ft] offshore of the mean low water line). 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). Construction of the proposed landside facilities would not result in impacts to beneficial uses of the floodplain.*

- ***Cultural resources****: There would be no impacts to cultural resources at landfall for the proposed USWTR Sites A, C, and D. There have been forts on Sullivan's Island since the Revolutionary War and the Ft. Moultrie National Monument is a unit of the Fort Sumter National Monument, so the area in general has cultural and historical significance. It is likely that the actual location of the CTF could be chosen such that impact to these resources could be avoided.*

- ***Air quality****: There would be no new sources of air pollutants at the landside facility at any of the proposed USWTR sites. Furthermore, the Clean Air Act (CAA) conformity rules would not apply to the landside facilities or in near-shore 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 worker automobiles. These impacts would be minor and would be short-term in nature.*

- ***Hazardous materials:*** *Onshore construction and operation of the 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.*

ES.5.3.5 Coastal Zone Management

Federal agency activities affecting a land or water use, or natural resource of 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 Navy has reviewed the coastal consistency policies enforced by the states for each of the proposed alternatives. The Navy has determined that implementation of the proposed action at the operationally preferred USWTR Site A would be consistent, to the maximum extent practicable, with the enforceable policies of the state of Florida. A negative determination has been prepared and submitted to the state of Georgia.

ES.5.4 Summary of Environmental Impacts

Table ES-3 provides a summary of the anticipated environmental impacts at each of the four alternative USWTR sites.

Table ES-3

Summary of Environmental Impacts

Environmental Resources		Site A	Site B	Site C	Site D
	Geology, Bathymetry and Substrate, and Water Quality	There would be no significant impact or significant harm.	There would be no significant impact or significant harm.	There would be no significant impact or significant harm.	There would be no significant impact or significant harm.
	Plankton and Benthos	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.

Table ES-3

Summary of Environmental Impacts

Environmental Resources		Site A	Site B	Site C	Site D
Non-Acoustic Environmental Impacts	Fish	There would be no significant impact or significant harm to fish.	There would be no significant impact or significant harm to fish.	There would be no significant impact or significant harm to fish.	There would be no significant impact or significant harm to fish.
	Essential Fish Habitat	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH. There would be potential impacts to the North Florida Marine Protected Area (MPA). The Navy is consulting with NMFS to avoid / reduce impacts.	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH. Potential significant impact to biogenic reef EFH if *Lophelia* Reefs are impacted. There would be potential impacts to the Charleston Deep Artificial Reef MPA. The Navy would consult with NMFS to avoid / reduce impacts.	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH. Potential significant impact to biogenic reef EFH if *Lophelia* Reefs are impacted. The Navy would consult with NMFS to avoid / reduce impacts.	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH.
Non-Acoustic Environmental Impacts (Cont'd)	Sea Turtles and Marine Mammals	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.	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.	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.	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.
	Seabirds and Migratory Birds	No significant impact to seabirds or migratory birds would occur.	No significant impact to seabirds or migratory birds would occur.	No significant impact to seabirds or migratory birds would occur.	No significant impact to seabirds or migratory birds would occur.
	Endangered and Threatened	<u>Species</u> There may be an effect to ESA-	<u>Species</u> There may be an effect to ESA-	<u>Species</u> There may be an effect to ESA-	<u>Species</u> There may be an effect to ESA-

Table ES-3

Summary of Environmental Impacts

Environmental Resources		Site A	Site B	Site C	Site D
	Species	listed species. The Navy is consulting with the NMFS to avoid / reduce impacts. Critical Habitat To avoid / reduce potential impacts on North Atlantic right whale critical habitat, the Navy is consulting with the NMFS in compliance with ESA.	listed species. The Navy would consult with the NMFS to avoid / reduce impacts. Critical Habitat No designated critical habitats occur within the range.	listed species. The Navy would consult with the NMFS to avoid / reduce impacts. Critical Habitat No designated critical habitats occur within the range.	listed species. The Navy would consult with the NMFS to avoid / reduce impacts. Critical Habitat No designated critical habitats occur within the range.
Acoustic Environmental Impacts	Marine Mammals	ESA-listed Species Level B harassment of two species (North Atlantic right whale and humpback whale). Non-ESA listed Species B harassment of ten species. 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.	ESA-listed Species Level B harassment of two species (North Atlantic right whale and humpback whale). Non-ESA listed Species Level B harassment of nine species. 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.	ESA-listed Species Level B harassment of one ESA-listed species (North Atlantic right whale). Non-ESA listed Species Level B harassment of eleven species. 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.	ESA-listed Species Level B harassment of three species (North Atlantic right whale, fin whale, and sperm whale). Non-ESA listed Species Level B harassment of welve species. 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.

Table ES-3

Summary of Environmental Impacts

Environmental Resources		Site A	Site B	Site C	Site D
	Fish	There would be no significant impact to fish populations.	There would be no significant impact to fish populations.	There would be no significant impact to fish populations.	There would be no significant impact to fish populations.
	Scuba Diving	Following Navy operating procedures, no impacts to divers would occur.	Following Navy operating procedures, no impacts to divers would occur.	Following Navy operating procedures, no impacts to divers would occur.	Following Navy operating procedures, no impacts to divers would occur.
Socioeconomics		There would be no significant impact.	There would be no significant impact.	There would be no significant impact.	There would be no significant impact.
Cultural Resources		There would be no significant impact.	There would be no significant impact.	There would be no significant impact.	There would be no significant impact.
Landside Resources		There would be no significant impact. Prior to installation of the range, the Navy would coordinate with the appropriate resource agency(s) and implement appropriate avoidance/ mitigation measures.	There would be no significant impact. Prior to installation of the range, the Navy would coordinate with the appropriate resource agency(s) and implement appropriate avoidance/ mitigation measures.	There would be no significant impact. Prior to installation of the range, the Navy would coordinate with the appropriate resource agency(s) and implement appropriate avoidance/ mitigation measures.	There would be no significant impact. Prior to installation of the range, the Navy would coordinate with the appropriate resource agency(s) and implement appropriate avoidance/ mitigation measures.
Coastal Zone Management		The proposed action is consistent to the maximum extent practicable with the enforceable policies of the Florida coastal zone management program.	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the South Carolina coastal zone management program.	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the North Carolina coastal zone management program.	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the Virginia coastal zone management program.

ES.5.5 Cumulative Impacts

With respect to potential landside cumulative impacts, the construction of USWTR landside facilities at any of the four proposed sites – A, B, C, or D – would have no significant cumulative impacts. At all locations, the cable would be installed in conduit by directional drilling and in a *trench to connect to the newly constructed CTF. This minor construction would not impact other uses (military and recreation) at any proposed site. Further, given the limited duration of the new construction activities and the relatively minor area of land disturbance, the cumulative impact of new construction, taken into consideration with other uses of the proposed USWTR areas, would not be significant.*

With respect to marine resources, the combination of potential impacts resulting from implementing the proposed action and other human activities (commercial fishing, vessel traffic, environmental contamination, etc.) or natural occurrences (e.g., climatic fluctuations, toxic algae blooms, etc.) can affect marine resources and their habitats. For North Atlantic right whales, ship strikes are believed to be a significant factor limiting the recovery of this species.

Currently the Navy conducts other Navy training activities at sea that have the potential to cause incremental acoustic effects to marine mammals. These include: naval surface fire support training, mine warfare exercises, sinking exercises of surface targets, and other active sonar training.

With regard to the incremental contribution of the proposed USWTR action, acoustic effects to marine mammals are expected to be primarily temporary behavioral effects. Mitigation measures have been designed and will be implemented during use of the USWTR in order to minimize any potential adverse impacts to marine mammals and to avoid any significant or long-term adverse impacts to the marine environment. The proposed action is not likely to affect annual rate of population growth or survival of marine mammals. Incremental impacts resulting from the proposed construction and use of the USWTR do not contribute significantly to the cumulative effect on marine mammals.

ES.6 Mitigation Measures

Effective training on the proposed USWTR dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities. Recognizing that such use may cause behavioral disruption of some marine mammal species within the range, the Navy will request an LOA from NMFS. The Navy has developed mitigation measures that would be implemented to protect marine mammals during Navy operations on the proposed USWTR range. These include:

- **Personnel training** in marine mammal spotting and reporting and lookout responsibilities.

- **Implementation of range operating procedures** to maximize the ability of operators to recognize instances when marine mammals are in the vicinity and to take appropriate action.

- **Conservation measures** that would involve long-term monitoring of marine mammals on the USWTR.

Further, consistent with the seasonality and locations where North Atlantic right whales are known to occur, the Navy proactively adopted protective measures in December 2004 to reduce the potential for Navy vessels transiting to and from mid-Atlantic ports to strike migrating right whales. The measures apply to all Navy vessel transits, including those vessels that would transit to and from the proposed USWTR.

With respect to mitigation measures related to landside facilities, the proposed CTF at each of the four proposed USWTR landfall sites (i.e., Naval Station Mayport, Ft. Moultrie National Monument, Onslow Beach, and Wallops Island) would be sited to avoid existing wetland areas. While installing the landside portion of the trunk cable, directional drilling would be used to avoid wetlands to the maximum extent practicable.

No impacts to estuarine wetlands would be anticipated with implementation of the proposed action at the preferred Site A landfall site. Current conservation measures in place at NS Mayport beach would minimize or eliminate the potential for adverse impact to the nesting activities of loggerhead and green sea turtles. It is anticipated that no additional mitigation measures would be required there.

With respect to the proposed Site B landfall site at Ft. Moultrie, there would be no effect to the nesting activities of the federally threatened loggerhead sea turtle; installation would not be conducted during nesting months. Consultation with the USFWS would be conducted before initiating any construction activities. Consultation with the National Park Service (NPS) and the South Carolina State Historic Preservation Office would be conducted to avoid impacts to the Ft. Moultrie historic site as a result of the installation of the trunk cable and construction of the CTF.

At Site C, the only potential adverse environmental impacts anticipated could be to protected species. Adherence to the conservation measures currently in place, developed through ESA Section 7 consultations between MCB Camp Lejeune and the USFWS, would eliminate the potential for adverse effects on the seabeach amaranth. There would be no effect to the nesting activities of the federally threatened loggerhead sea turtle and green sea turtle; installation would not be conducted during nesting months. Consultation with the USFWS would be conducted before initiating any construction activities. There would be no effect to the nesting activities of the federally endangered piping plover; installation would not be conducted during nesting months. In the latter two cases, mitigation measures would be taken consistent with those developed through ESA Section 7 consultations between MCB Camp Lejeune and the USFWS.

At Site D, Wallops Island, it is anticipated that no additional mitigation measures would be required because there would be no effect to threatened or endangered species; wetlands would not be impacted.

ES.7 Public Review Process and Response to Comments

Public involvement in the review of draft EISs (DEISs) is stipulated in 40 CFR Part 1503 of the CEQ regulations implementing NEPA and the Navy's NEPA regulations (32 CFR Part 775). These regulations provide for active solicitation of public comment via the scoping process, public comment periods, and public hearings.

The scoping process for this OEIS/EIS was initiated by the publication of the notice of intent (NOI) in the *Federal Register* on May 13, 1996. At that time, the range was called a shallow water training range. Scoping letters were sent to members of Congress and federal, state, and local agencies, as well as members of the general public, notifying them of the beginning of the OEIS/EIS process. In 2005, the range name was updated to undersea warfare training range (USWTR). In October of 2005, the draft OEIS/EIS was published and a public comment period ensued that included three public meetings (Chincoteague, Virginia; Morehead City, North Carolina; and Jacksonville, Florida).

On September 21, 2007, the Navy issued a NOI to prepare a revised draft OEIS/EIS and reopened public scoping for a period that ended on October 22, 2007. The revised draft OEIS/EIS incorporated analysis of an additional alternative site and reflected modification of the methodology used to analyze behavioral impacts on marine mammals. During this time, comments pertaining to issues to be addressed in the revised draft OEIS/EIS, and heretofore not submitted were invited. With the publication of the revised draft OEIS/EIS, the public again had the opportunity to comment during the 45-day public comment period. During this period, a public meeting was held at each of the aforementioned locations and also in North Charleston, South Carolina.

ES.7.1 Comments Received to the 2008 Draft OEIS/EIS

Comments received during the public comment period fell into the following major categories:

- Acoustic modeling process and results, including biological assumptions, consideration of the impacts of reverberation, sonar characteristics, and Level A and B harassment thresholds, among others;
- Assessment of fish, sea turtle, seabird, and marine mammal population/distribution;
- Sonar impacts on fish, sea turtles, seabirds, and marine mammals;
- Impacts on North Atlantic right whales;
- Marine mammal strandings and ship strikes;

- Socioeconomic impacts, including potential impacts on commercial and recreational fishing, diving, etc.;
- Landside impacts;
- Impacts on marine habitat, including marine life and marine protected areas;
- Impacts to cultural resources;
- Cumulative impacts;
- Solid and hazardous waste issues, including debris, entanglement, and toxicity;
- Mitigation measures;
- NEPA compliance and discussion of the proposed action; and,
- Other regulatory compliance (e.g., MMPA, ESA, etc.).

ES.7.2 Substantive Changes between Draft OEIS/EIS and Final OEIS/EIS

In this final OEIS/EIS, the Navy addressed comments received during the 2008 public comment period and modified the text as appropriate. The primary text that has been updated in this final OEIS/EIS includes:

- Ecology (Subchapter 3.2)
- Ecological Impacts (Subchapter 4.2)
- Acoustic Effects (Subchapter 4.3)
- Cumulative Impacts (Subchapter 4.8)
- Mitigation Measures (Chapter 6).

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LIST OF ACRONYMS & ABBREVIATIONS

ABR	auditory brainstem response
ACFCMA	Atlantic Coastal Fisheries Cooperative Management Act
ACL	acoustic command link
ACSC	AEGIS Combat Systems Center
ADCAP	advanced capability
ADC	acoustic device countermeasure
AEAU	Alternate Energy and Alternate Use
AEGIS	Advanced Electronic Guidance and Instrumentation System
AEP	auditory-evoked potential
AFB	Air Force base
Ag	silver
AIP	air-independent propulsion
$Al(ClO_4)_3$	aluminum-perchlorate
AIWW	Atlantic Intracoastal Waterway
ALCLO	pyrotechnic initiator
ALFS	Airbourne, Low Frequency Sonar
AMVER	Automated Mutual-Assistance Vessel Rescue System
ANG	Air National Guard
APPS	Act to Prevent Pollution from Ships
ARTCC	Air Route Traffic Control Center
ASA	Abandoned Shipwreck Act
ASMFC	Atlantic States Marine Fisheries Commission
ASROC	antisubmarine rocket
ASSRT	Atlantic Sturgeon Status Review Team
ASW	antisubmarine warfare
ATCAA	Air Traffic Control Assigned Airspace
ATOC	acoustic thermometry of ocean climate
AtoN	Aid to Navigation
ATS	asymptotic threshold shift
AUTEC	Atlantic Undersea Test and Evaluation Center
AWOIS	Automated Wreck and Obstruction Information System
BGEPA	Bald and Golden Eagle Protection Act
BRAC	Base Realignment and Closure
BSS	buoyancy subsystem
BT	bathythermograph
BTar	Bombing Target
C	Celsius
CAA	Clean Air Act
CAMA	Coastal Area Management Act
CASS	Comprehensive Acoustic Simulation System

CBPA	Chesapeake Bay Preservation Area
CCD	coastal consistency determination
CCL	curved carapace length
CD-ROM	compact disc, read-only memory
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CETAP	Cetacean and Turtle Assessment Program
CFMETR	Canadian Forces Maritime Experimental and Test Ranges
CFR	Code of Federal Regulations
CG	guided missile cruiser
CH_4	methane
CHASN	Charleston, South Carolina
CH_2O	formaldehyde
CHPT	Cherry Point
cm	centimeter
CNA	Center for Naval Analyses
CNO	Chief of Naval Operations
CO	carbon monoxide
CO_2	carbon dioxide
COMPTUEX	composite training unit exercise
CREEM	Centre for Environmental and Ecological Modelling
CRMP	Coastal Resources Management Program
CSG	carrier strike group
CT	computerized tomography
CTF	cable termination facility
Cu	copper
CV	aircraft carrier
CWA	Clean Water Act
CZ	convergence zone
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Plan
dB	decibel
DBDB-V	Digitized Bathymetric Data Base - Variable Resolution
DCS	decompression sickness
DDG	guided missile destroyer
deg	degree
DEIS	draft environmental impact statement
DELMARVA	Delaware, Maryland, Virginia
DICASS	Directional Command Activated Sonobuoy System
DOSITS	Discovery of Sound in the Sea [University of Rhode Island]
DMA	Dynamic Management Areas

DOC	Department of Commerce
DoD	Department of Defense
DoI	Department of the Interior
DoN	Department of the Navy
DOSITS	Discovery of Sound in the Sea
DSL	deep scattering layer
D-tag	Digital acoustic recording tag.
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
Eh	oxidation
EIS	environmental impact statement
EL	energy flux density level
EMATT	expendable mobile acoustic training target
EMF	electromagnetic field
EO	executive order
EPAct	Energy Policy Act of 2005
ERL	effects range low
ERM	effects range median
ESA	Endangered Species Act
ESG	Environmental Sciences Group, Royal Military College of Canada
et al.	et alia (and others)
EWS	Early Warning System
EXTORP	exercise torpedo
fm	fathom
F	Fahrenheit
FACSFAC	Fleet Area Control and Surveillance Facility
FCMP	Florida Coastal Management Plan
FE	federal endangered (species)
FEIS	final environmental impact statement
FeO	ferrous oxide
FFG	frigate
FFWCC	Florida Fish and Wildlife Conservation Commission
FDEP	Florida Department of Environmental Protection
FL	Florida
FLDEP	Florida Department of Environmental Protection
FM	frequency modulation
FMC	Fishery Management Council
FMP	fishery management plan
FMRI	Florida Marine Research Institute
FRTP	Fleet Response Training Plan
ft	foot

FWC-DMF	Florida Fish and Wildlife Conservation Commission - Division of Marine Fisheries Management
FWPCA	Federal Water Pollution Control Act
FWRI	Fish and Wildlife Research Institute
FY	fiscal year
g	gram
GA	Georgia
gal	gallon
GAM	generalized additive models
GDEMV	Generalized Digital Environmental Model Variable
GIS	Geographic Information System
GMFMC	Gulf of Mexico Fishery Management Council
GOMEX	Gulf of Mexico
GoMOOS	Gulf of Maine Ocean Observing System
GRAB	Gaussian RAY Bundle
GTFP	green turtle fibropapillomatosis
H_2	hydrogen
H_2O	water
HAPC	habitat area of particular concern
HCl	hydrochloric acid
HCN	hydrocyanic acid
HF	high frequency
HFA	high frequency active
HITS	historical temporal shipping
HMS	highly migratory species
H_2S	hydrogen sulfide
HSO_3	bisulfite
Hz	Hertz
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICOADS	International Comprehensive Ocean-Atomosphere Data Set
IFAW	International Fund for Animal Welfare
IFH	improved flex hose
IHA	incidental harassment authorization
IMDCC	Interagency Marine Debris Coordinating Committee
IMF	intermediate maintenance facility
in	inch
ISFMP	Interstate Fisheries Management Program
ITS	incidental take statement
IUSS	Integrated Undersea Surveillance System
IWC	International Whaling Commission

LIST OF ACRONYMS & ABBREVIATIONS (CONT'D)

JAX	Jacksonville, Florida
JTFEX	joint task force exercises
KCl	potassium chloride
K_2CO_3	potassium carbonate
kg	kilogram
kHz	kilohertz
km	kilometer
KOH	potassium hydroxide
kt	knot
L	liter
lbs	pounds
LC	lethal concentration
LDEO	Lamont-Doherty Earth Observatory
LF	low frequency
LFA	low frequency active
Li	lithium
LiBr	lithium bromide
$LiSO_2$	lithium sulfur dioxide
LiO_2	lithium dioxide
LIPA	Long Island Power Authority
LOA	letter of authorization
µ	micro
µg/L	micrograms per liter
µPa	micro Pascal
µT	microTesla
m	meter
MAB	mid-Atlantic bight
MAD	magnetic anomaly detection
MAFMC	Mid-Atlantic Fisheries Management Council
MARPOL	International Convention for the Prevention of Pollution from Ships
MAUS	mid-Atlantic U.S.
MBTA	Migratory Bird Treaty Act
MCAS	Marine Corps air station
MCB	Marine Corps base
MF	mid-frequency
MFA	mid-frequency active
mg	milligram

mi	mile
min	minute
MINEX	mine warfare exercise
MIW	mine warfare
MMEM	Marine Mammal Effect Model
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMRP	Marine Mammal Research Program
MMS	Minerals Management Service
MOUT	Military Operations in Urban Terrain
MPA	Marine Protected Area
MRA	marine resources assessment
MRFSS	marine recreational fishery statistics survey
MSA	Magnuson-Stevens Act
MU	management unit
N_2	nitrogen
NAAQS	National Ambient Air Quality Standards
NAO	North Atlantic Oscillation
NARWC	North Atlantic Right Whale Consortium
NAS	naval air station
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facilities Engineering Command
NAVOCEANO	Naval Oceanographic Office Date User Warehouse
NAVSEA	Naval Sea Systems Command
NAVSEAINST	Naval Sea Systems Command Instruction
NC	North Carolina
NCCOSC	Naval Command Control & Ocean Survey Center
NCDCM	North Carolina Division of Coastal Management
NCDMF	North Carolina Division of Marine Fisheries
NDAA	National Defense Authorization Act
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NEUS	Northeastern U.S.
NEW	net explosive weight
NGA	National Geospatial-Intelligence Agency
NH_3	ammonia
NHHC	Naval History and Heritage Command
NHPA	National Historic Preservation Act
NITS	noise-induced threshold shift
NIXIE	anti-torpedo decoy

List of Acronyms & Abbreviations (cont'd)

NMFS	National Marine Fisheries Service
NM	nautical mile
NO_2	nitrogen dioxide
NO_X	nitrogen oxide
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NODE	Navy OPAREA Density Estimate
NOI	notice of intent
NOSC	Naval Ocean Systems Center
NOTAM	notice to airmen
NOTMAR	notice to mariners
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NR	not reported
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NS	naval station
NSFS	naval surface fire support
NSW	naval special warfare
NSWCIH	Naval Surface Warfare Center Indian Head
NSY	naval shipyard
NUMA	National Underwater and Marine Agency
NUWC	Naval Undersea Warfare Center
NWI	National Wetlands Inventory
OAML	Oceanographic and Atmospheric Master Library
OC	Ocean Conservancy
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OEA	overseas environmental assessment
OEIS	overseas environmental impact statement
ONI	Office of Naval Intelligence
OPAREA	operating area
OPNAVINST	Chief of Naval Operations Instruction
ORD	operational requirements document
oz	ounce
Pa	Pascal
PADI	Professional Association of Diving Instructors
Pb	lead
$PbCl_2$	lead chloride

$PbCO_3$	lead carbonate
PbO_2	lead dioxide
PE	parabolic equation
PEA	programmatic environmental analysis
PEL	permissible exposure limit
PFP	Proposed Final Program
PL	public law
pH	alkalinity
PNAS	Proceedings of the National Academy of Sciences
ppb	parts per billion
ppm	parts per million
PQS	personal qualification standard
PRC	People's Republic of China
psu	practical salinity units
PTS	permanent threshold shift
PUTR	portable underwater tracking range
PVC	polyvinyl chloride
RDT&E	research, development, testing and evaluation
REXTORP	recoverable exercise torpedo
RHA	Rivers and Harbors Act
RI	Rhode Island
RL	received level
RMA	resource management area
rms	root mean square
ROC	range operations center
ROD	record of decision
ROS	reactive oxygen species
ROW	right-of-way
RPA	resource protection area
RUWPA	Research Unit for Wildlife Population Assessment
s	second
SAB	South Atlantic bight
SAFMC	South Atlantic Fisheries Management Council
SAR	stock assessment report
SAV	submerged aquatic vegetation
SC	South Carolina
SCAES	South Carolina Agricultural Station
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCEPS	stored chemical energy propulsion system
SCL	straight carapace length

LIST OF ACRONYMS & ABBREVIATIONS (CONT'D)

SCSPA	South Carolina State Ports Authority
SD	standard deviation
SEAMAP	Southeast Area Monitoring and Assessment Program
SEFSC	Southeast Fisheries Science Center
SEIS	Supplemental Environmental Impact Statement
SEL	sound exposure level
SEUS	southeastern U.S.
SF_6	sulfur hexafluoride
SFH	strong flex hose
SHPO	State Historic Preservation Office
SINKEX	sinking exercise of surface targets
SIPRNET	Secret Internet Protocol Router Network
SL	source level
SMA	Seasonal Management Areas
SMCA	Sunken Military Craft Act
SO_2	sulfur dioxide
sonar	sound navigation and ranging
SOSUS	Sound Surveillance System
SPL	sound pressure level
SSBN	Ballistic Nuclear Submarine
SSC	Surveillance Support Center
SSGN	Nuclear Guided Missile Submarine
SSN	Attack Submarine (nuclear powered)
SSI	sea-shore interface
SST	sea surface temperature
SUA	Special Use Airspace
SURTASS LFA	Surveillance Towed Array Sensor System - Low Frequency Active
SWMU	solid waste management unit
SVP	sound velocity profile
TSD	temperature-dependant sex determination
T&E	test and evaluation
TED	Turtle Exclusion Device
TEU	twenty-foot equivalent
TEWG	Turtle Expert Working Group
TL	transmission loss
TS	threshold shift
TTS	temporary threshold shift
TWA	time-weighted average
ULT	unit level training
UME	unusual mortality event
UNCW	University of North Carolina-Wilmington

LIST OF ACRONYMS & ABBREVIATIONS (CONT'D)

UNDET	underwater detonation
UQC	underwater mobile sound communications
U.S.	United States
USACE	U.S. Army Corps of Engineers
USARPA	U.S. Army Publications Agency
USC	U.S. Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USMC	U.S. Marine Corps
USNS	U.S. Naval Ship
USVI	U.S. Virgin Islands
USW	undersea warfare
USWTR	Undersea Warfare Training Range
VA	Virginia
VACAPES	Virginia Capes
VAST/IMPASS	Virtual At-Sea Training/Integrated Maritime Portable Acoustic Scoring and Simulator
VHF	very high frequency
yd	yard
VDGIF	Virginia Department of Game and Inland Fisheries
VDHR	Virginia Department of Historic Resources
VIMS	Virginia Institute of Marine Science
VLA	vertical launch anti-submarine rocket
VMRC	Virginia Marine Resources Commission
VRCA	Virginia Research Center for Archaeology
w	wavelength
W-(number)	warning area (with appropriate number)
WFF	Wallops Flight Facility
WHOI	Woods Hole Oceanographic Institution
XBT	expendable bathythermograph

1 PURPOSE AND NEED

The proposed action is to place undersea cables and sensor nodes in a 1,713-square-kilometer (km^2) (500-square-nautical-mile [NM^2]) area of the ocean creating an undersea warfare training range (USWTR), and to use the area for antisubmarine warfare (ASW) training. Such training would typically involve up to three vessels and two aircraft using the range for any one training event, although events would typically involve fewer units. The instrumented area would be connected to the shore via a single trunk cable. The proposed action would require logistical support for ASW training, including the handling (launch and recovery) of exercise torpedoes (non-explosive) and submarine target simulators.

1.1 Purpose of the Proposed Action

The purpose of the proposed action is to enable the U.S. Navy to train effectively in a shallow water environment (37 to 274 meters [m], or 120 to 900 feet [ft], in depth) at a suitable location for Atlantic Fleet ASW capable units. The 37-to-274 m (120-to-900 ft) depth parameter for the range was derived from collectively assessing depth requirements of the platforms that would be using this range, and approximates the water depth of potential areas of conflict that the Navy has identified.

1.2 Need for the Proposed Action

There are four fundamental reasons why the Navy needs to have an instrumented undersea warfare training range off the east coast of the United States, these are:

- **Worldwide Deployment to Littoral Areas.** Atlantic Fleet units deploy worldwide, and shifts in the military strategic landscape require increased naval capability in the world's shallow, or littoral, seas, such as the Arabian Sea, the South China Sea, and the Korean Sea. Training effectively for these littoral environments requires the availability of realistic conditions in which actual potential combat situations can be adequately simulated:

  "*The 21st century environment is one of increasing challenges, due to the littoral environment in which we operate and advanced technologies that are proliferating around the world. Operations in the future will be centered on*

> Today's Operating Environment
> - High traffic density and related noise
> - Poor sound propagation due to shallow water characteristics
> - High technology enemies
> - Atypical challenges from rogue states and terrorists
> - Long term operations near shore in a shallow water environment

dominating near-land combat, rapidly achieving area control despite difficult sound propagation profiles and dense surface traffic. The operating environment will be cluttered and chaotic, and defeating stealthy enemies will be an exceptional challenge." – Anti-Submarine Warfare Concept of Operations for the 21st Century (DoN, 2004c).

- **Threat of Modern Diesel Submarines**. The current global proliferation of extremely quiet submarines poses a critical threat to the maritime interests of the U.S. These silent diesel submarines, easily obtainable by potential adversaries, are capable of prolonged, silent, submerged operations in confined, congested littoral regions where acoustic conditions make detection significantly more challenging than in deep water. These silent vessels can get well within 'smart' (i.e., self-guided) torpedo or anti-ship missle range of U.S. forces before there is a likelihood of their being detected by passive sonar "listening." For this reason, use of, and training with, active sonar is crucial to today's ASW, U.S. operational readiness, national defense, and homeland security. Such training is critical to our ability to deliver fighting forces overseas and to protect civilians and cargo in transit on the world's oceans.

- **U.S. World Role**. The role of the U.S. in keeping critical sea lanes open makes it imperative that U.S. military forces are the best trained, prepared, and equipped in the world. ASW is a Navy core capability and is a critical part of that mission. The Navy is the only Department of Defense (DoD) service with an ASW responsibility, and must be trained and capable in littoral water operations to assure access for the U.S. and our allies to strategic areas worldwide.

- **Mission Readiness and Fulfillment**. The Navy's primary mission is to maintain, train, equip, and operate combat-ready naval forces capable of resolving conflicts, deterring aggression, and maintaining freedom of the seas. Training with the actual sensors and weapons systems aboard their own ships, submarines, or aircraft, in a complex operational setting with a realistic scenario is key to maintaining Fleet combat readiness and to survival in actual wartime conditions.

  Timely and accurate feedback of training performance to exercise participants and the ability to rapidly reconstruct the training event contribute significantly to the quality of this complex training. These capabilities may only be realized through the use of an instrumented, at-sea training range. At present, the only operational Atlantic instrumented training range is located in a deep-water environment, requiring that results be extrapolated to apply to the critically different conditions of shallow water; speculation and interpretation are required to evaluate crew and equipment performance, reducing the authenticity of the feedback.

The proposed USWTR provides an environment:

- that is consistent with real-world threat situations.
- where training exercises can be conducted under safe and controlled conditions.
- with critically important real-time feedback that eliminates the need for iterative training events to validate and confirm results.

In addition, Section 5062 of Title 10 of the U.S. Code (USC) contains a legal mandate for such training as would be provided by the proposed range. Title 10 directs the Chief of Naval Operations (CNO) to organize, train, and equip all naval forces for combat. The CNO fulfills this direction by conducting training activities during a training cycle prior to deployment for actual operations. First, personnel learn and practice basic combat skills through basic-level or unit-level training. Basic skills are then refined at the intermediate and advanced levels in progressively more difficult, complex, and larger-scale exercises conducted at increasing tempos, referred to as integrated training. When training is complete, naval forces can function effectively independently, or as part of a coordinated fighting force, can accomplish multiple missions, and are able to fulfill Title 10's mission and readiness mandate.

The ability to train year-round is required if the Navy is to meet the requirements and schedules associated with the *Fleet Response Training Plan* (FRTP) (DoN, 2007i) and the potential for surge situations (i.e., immediate deployment of forces). To meet potential surge situations, the *Fleet Response Training Plan* requires that the Navy have five or six carrier strike groups (CSGs) ready to deploy within 30 days of notification and an additional one or two CSGs ready to deploy within 90 days. To satisfy this requirement, the Navy must have access to training areas all year to ensure that a sufficient number of fully trained surface units are always prepared for deployment.

Finally, the training value of the proposed action ultimately benefits all DoD forces whose missions are in any way tied to maritime operations, homeland security, or are dependent on access to strategic littoral areas of the world. Silent submarines are an important threat to U.S. forces, civilians, and materiel, and potentially to national security. The increasing likelihood of combat in shallow, littoral areas, as opposed to the open ocean or under ice requires that the Navy is fully trained for these conditions. Such training can best be accomplished with an instrumented undersea warfare training range appropriately located in a shallow water environment.

1.3 Supporting Information

1.3.1 Worldwide Deployment to Littoral Areas

One of the cornerstones of effective training is the availability of venues providing realistic combat-like conditions. A complicating factor facing the Navy today is the nature of the shallow, or littoral, regions in which submarines can operate. These littoral regions are frequently confined, congested water and air space occupied by allies, adversaries, and neutral parties alike, making identification of friend or foe profoundly difficult. Worse, as cited previously, acoustic conditions in littoral areas can make detection of submerged submarines significantly more challenging than in deep water. Unfortunately, these are the very areas where potential U.S. adversaries are most likely to concentrate and layer their defenses. Diesel submarines are perfectly suited for maneuvering in littoral regions; they place U.S. naval units at risk.

The only answer is adequate training to counter the threat. In the military context, training means gaining the physical skills, ability, and knowledge to perform and survive in combat. The key to combat effectiveness is realistic training in the air, on land, and at sea – the single greatest tool the military has in preparing and protecting our naval forces. It is essential for U.S. forces to train as they would fight. “Train as we fight” is not just a phrase - it is a statement of the absolute necessity to realistically train our naval forces for the conditions in which they may find themselves while protecting our forces globally and our nation at home. Realistic training requires a training environment that replicates anticipated combat conditions and provides a means to accurately evaluate crew performance. The proposed USWTR provides an instrumented range in the required environment.

1.3.2 Threat of Modern Diesel Submarines

There are many potential challenges in an era of arms proliferation and relatively easy access to basic materials and methodology. Many small countries and potential adversaries possess sophisticated weapons systems, including modern diesel submarines and their related weapons ranging from sub-deployed mines through torpedoes to anti-ship missiles. Published naval strategies of potential adversaries, including Iran and North Korea, have stated that the submarine is the single most potent ship in their fleets.

Modern diesel submarines are relatively inexpensive and are the most cost-effective platform for the delivery of several types of weapons, including long-range anti-ship cruise missiles, a variety of anti-ship mines, and modern homing torpedoes. At close range, modern submarines will likely employ one or two acoustic homing (with a seeker head utilizing either active or passive sonar), or wake-homing torpedoes (are able to sense and follow the wake of surface ships) instead of the “spread” of blind, simple course-running torpedoes fired against a single target in WWII. This technological advance, in addition to prolonged battery life or use of air-independent propulsion means, has greatly increased the lethality of a single submarine.

With their stealth and ability to operate independent of escort vessels, submarines are very effective in attacking surface ships with torpedoes and missiles. Potential adversarial nations are investing heavily in submarine technology, including designs for nuclear attack submarines, strategic ballistic missile submarines, and advanced diesel submarines (see Table 1-1). The submarine is viewed as the perfect “anti-access” weapon to block crossroads and deny access to areas of U.S. interest. Because submarines are inherently covert, they can conduct intrusive operations in sensitive areas and can be inserted early with minimal likelihood of being detected.

In 2007, 37 countries were credited with a total of 534 submarines (Table 1-1), operational or being built. Other than the U.S., 36 countries were credited with 466 submarines, of which 307 are diesel submarines. Their combination of quiet operation, effective weapons, and reduced cost provides a substantial and multifaceted combat capability at a level affordable by many nations. Although total inventories of active combatant submarines fell to below 400 in 2004, half the total in the early 1990s, this was primarily due to the destruction of obsolete, decrepit units, notably by the Russian Federation and the People’s Republic of China (PRC). Today’s inventory has much more modern technology and presents a significantly more effective force (Baker, 2004).

It is also apparent that the number of modern missile-firing submarines is on the rise, and it is possible for these submarines to threaten Americans at home. The Russian Federation and the PRC have publicly declared that the submarine is the centerpiece of their respective navies. As China’s economy grows, the country will be able to purchase the best available Russian submarines and weapons systems to support their political goal of controlling the approaches and seas around Taiwan, the Spratly Islands, and the South China Sea (Farrell, 2003). In October 2006, a Chinese *Song*-class diesel-powered attack submarine followed the U.S. carrier *Kitty Hawk* and its accompanying warships undetected and surfaced within five miles of the carrier.

Further, published naval strategies of potential adversaries, including Iran and North Korea, have expressed similar strategic doctrine. A number of Southeast Asian countries are taking delivery or have ordered advanced, stealthy submarines armed with state-of-the-art missiles and torpedoes capable of striking targets at sea or on land far from their home ports. The competition threatens to shift the power balance among some of the region’s long-standing military rivals and poses a potential threat to key trade routes. It was anticipated that China would take delivery of up to 4 more advanced Russian-built KILO-class diesel submarines which, combined with the 12 KILO-class submarines they already have, make up a formidable force that could allow China to blockade Taiwan’s ports (Baker, 2003).

Competition between China and India for maritime influence has added impetus to India’s plan to boost its submarine force with eight new acquisitions over the next decade. With continuing submarine acquisitions throughout the area, Asia’s key waterways could become as crowded and dangerous, on, and below the surface with submarines and ASW combatants hunting each other on a regular basis.

Table 1-1

World Submarine Inventory

Country	Nuclear	Nuclear Being Built	Conventional & Non-Nuclear AIP*	Conventional Being Built
Atlantic/Baltic/Mediterranean/Black				
Algeria			2	
Canada			4	
Egypt			4	
Germany			12	2
Greece			9	3
Israel			3	
Italy			7	2
Netherlands			4	
Norway			6	
Poland			5	
Portugal			1	2
Spain			4	8
Sweden			5	
Turkey			13	1
South America				
Argentina			3	
Brazil			5	
Chile			4	
Columbia			2	
Ecuador			2	
Peru			6	
Venezuela			2	
Western Pacific/Indian Ocean				
Australia			6	
People’s Republic of China	6	5	54	4
India		2	16	6
Indonesia			2	6
Iran			3	
Japan			18	5
Malaysia				2

Table 1-1 (cont'd)

World Submarine Inventory

Country	Nuclear	Nuclear Being Built	Conventional & Non-Nuclear AIP	Conventional Being Built
Western Pacific/Indian Ocean (con't)				
North Korea			55	
Pakistan			4	1
Singapore			4	2
South Africa			2	1
South Korea			9	9
U.S./U.K./France/Russia				
U.S.	70	8		
U.K.	4		10	7
France	10	1		6
Russia	47	5	21	2
Total Nuclear Powered	**137**			
Total Nuclear Building		**21**		
Total Conventional/Non-Nuclear AIP			**307**	
Total Conventional/Non-Nuclear AIP Building/Conversions				**69**
World Submarine Population (37 countries), Operational, Being Built, Planned, or Projected				**534**

Notes: World submarine population does not include mini-subs (midget and swimmer delivery vehicles), decommissioned submarines, or submarines for which operational status is doubtful.
"Being built" includes planned and projected submarines.
*AIP refers to air-independent propulsion.
Source: Based on Saunders, 2007.

Although a real possibility, it is impossible to predict with certainty what event would precipitate conflict in the region. The prospect provides an additional mandate for the Navy to ensure that all its forces are well trained in shallow water ASW, as depths between 30 and 305 m (100 and 1,000 ft) typify much of the waterways off of southeast Asia as shown in Figure 1-1 (indicated with light blue shading). The Navy's ability to be adequately trained is predicated on the availability of an instrumented undersea warfare training range in a shallow water coastal environment.

New-generation, ultra-quiet diesel and hybrid-powered submarines that can remain submerged for long periods of time pose a major threat to U.S. naval and allied forces and their coasts. World War II-designed diesel submarines had to surface or snorkel regularly in order to maintain their battery charge and could not move at speeds in excess of 37 km/h (20 knots) without depleting their batteries within an hour or less. Advanced, or hybrid, diesel propulsion systems by comparison allow for long-term submergence with high-speed underwater maneuvering and are a reality today. The Russian submarine builder, Rubin Design Bureau, now offers for sale a liquid oxygen and hydrogen fuel cell air-independent propulsion option that permits diesel submarines to remain submerged for weeks without snorkeling (Goldstein and Murray, 2003).

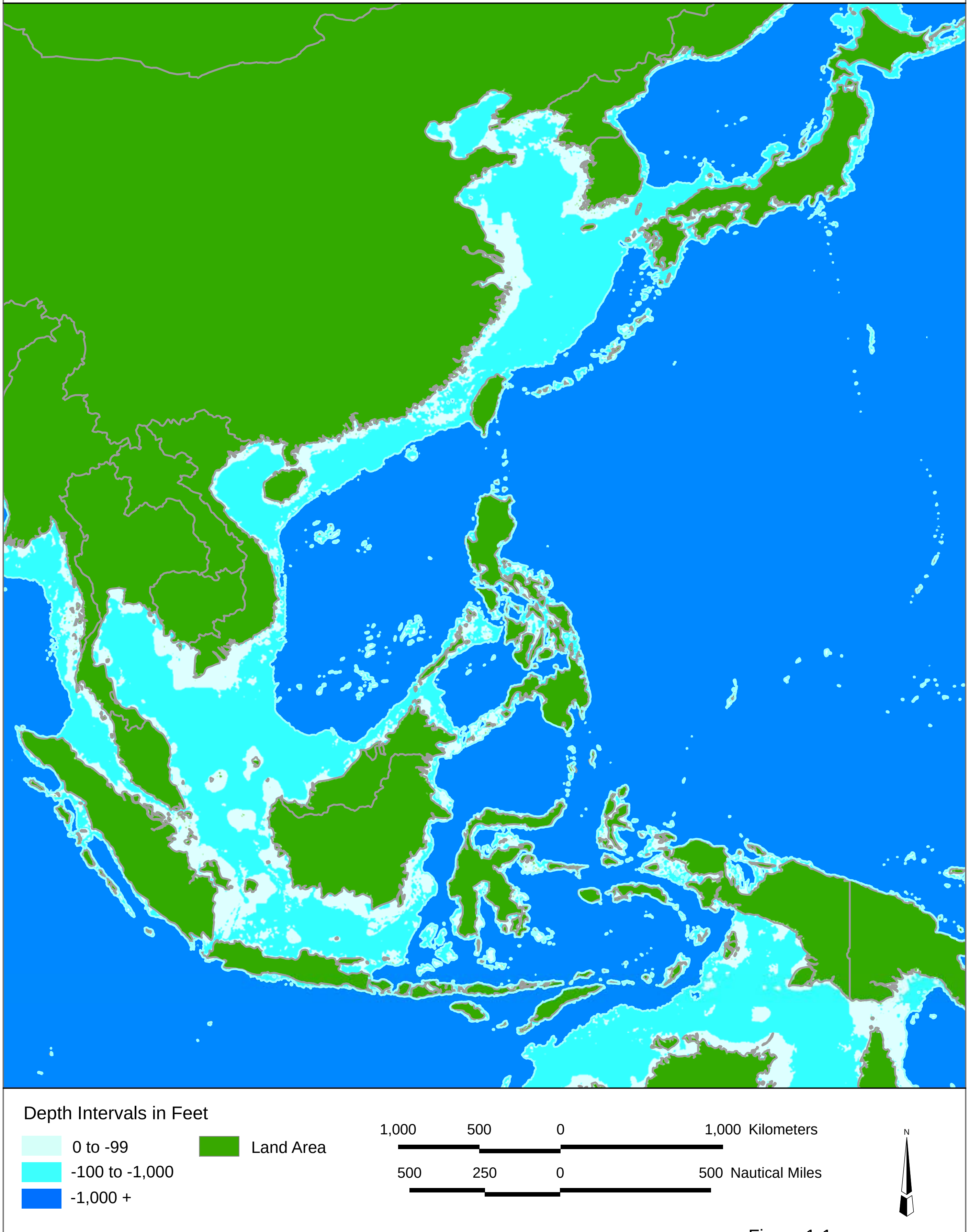
Submarines equipped with this type of propulsion will neither be restricted to operations in shallow water nor to slow speeds. A prepositioned diesel submarine conducting a quiet patrol on battery power is very difficult to detect – and with passive sonar, in some cases nearly impossible. The inability to detect a hostile submarine before it can launch a missile or a torpedo is a critical vulnerability that puts U.S. forces and merchant mariners at risk and, ultimately, threatens U.S. national security. A single diesel submarine that is able to penetrate U.S. or multinational task force defenses could cause catastrophic damage with the loss of American and allied lives. Further, at this time no Western navy seems to have viable countermeasures to either the wake homing torpedo or the modern very low flying, high speed, anti-ship missiles which can be both purchased to arm the KILO-submarine (Friedman, 2004). Even the threat of a quiet diesel submarine, in certain current circumstances, could greatly complicate U.S. or coalition naval force access to vital operational areas.

1.3.3 U.S. World Role

Recent world events have placed the U.S. military at center stage in the defense of the United States and its allies. Presently, the U.S. military is actively engaged throughout the world in a global war on terrorism. Additionally, for many years, the U.S. has played a significant role in the resolution of international disturbances and conflicts that threaten to disrupt the security and stability of regions abroad, in addition to threatening U.S. domestic security. Often these disruptions have been in the form of civil wars, territorial disputes, terrorism, natural disasters and other civil emergencies.

The spread of submarines incorporating new technologies will dramatically affect operational planning and execution by both friends and adversaries. Current and future enemies will likely

Representative Southeast Asia Water Depths



Source: National Geophysical Data Center (NGDC), ESRI

Figure 1-1

pose non-traditional, unpredictable threats by employing undersea warfare systems and devices including: bottom and moored mines, submerged launch torpedoes, anti-ship missiles, and powerful swimmer delivered explosive devices. Adversary undersea capabilities threaten population centers in friendly nations, military bases, equipment, and forces. When facing such enemies, our advantage lies in sea basing that employs capabilities to ensure sea supremacy for U.S. and allied forces.

U.S. military forces also must be prepared and trained to support homeland security, including the protection of U.S. territory, sovereignty, domestic population, and critical infrastructure. For example, the spread of undersea warfare technologies, some of which can be relatively inexpensive and easy to obtain, conceivably could threaten domestic port access or military and commercial vessel traffic along crucial domestic shipping routes. Whether threats are presented in the homeland or overseas environment, U.S. naval forces must be trained to provide full capabilities for the detection, location, and defense against an increasing undersea warfare threat.

An adversary seeking to challenge the U.S. militarily will often seek to stop or delay the flow of U.S. fighting forces. Since more than 95 percent of the equipment to support our fighting forces would flow into overseas theaters by sea, anything an adversary can do to attack shipping will have significant impact (Military Sealift Command, 2008). Further, history would lead any adversary to conclude that one of the best tools for stopping the flow of ships is the submarine.

Following are descriptions of some recent examples:

- During both Operation Enduring Freedom and Operation Iraqi Freedom, interdiction of ground force equipment flowing into Afghanistan and Iraq by sea by an adversary with submarines would have significantly increased the risk and vulnerability of U.S. Soldiers, Sailors, and Airmen, both afloat and ashore. Both operations would have resulted in a greater loss of American and allied lives, and it is possible that the outcomes could have been affected.

- In 2006, a U.S. Navy task force of nine ships and two passenger ships were used to evacuate over 7,000 U.S. citizens from Beirut, Lebanon, due to the military conflict between Israel and Lebanon. Preparations for another noncombatant evacuation operation were conducted off Liberia in June 2003. Similar events have played out many times over the past few decades. If a future rescue were to be needed in an area with a submarine threat, without adequate ASW capability such an operation would be extremely difficult, dangerous, and perhaps impossible.

- During recent tsunami relief efforts in Southeast Asia, naval ships at sea supported much of the humanitarian relief work, including support from a U.S. Navy hospital ship. Such humanitarian missions could also be seriously affected in the future by submarine-capable adversaries.

1.3.4 Mission Readiness and Fulfillment

The Department of the Navy (DoN) requires a USWTR in a shallow water environment off the east coast of the U.S. to support the Atlantic Fleet mission, namely, to ensure the Navy is able to plan and execute missions against a wide range of potential threats in the dynamic setting of the real world.

Our nation's capability to train its naval forces for combat cannot be taken for granted. One thing DoN has learned, through loss of life and capital, is that readiness is paramount. The ultimate objective of military readiness is to deter conflict when possible, win wars when necessary, and bring our troops home safely. This level of readiness is only effectively achieved through rigorous, realistic training. Realistic training forms the solid foundation of our credible combat capability, and it can not be accomplished without access to quality at sea training range complexes and operating areas to properly prepare our naval forces for the rigors of combat. The first time our naval forces conduct a realistic operation cannot, and should not, be during time of war.

The future will only add complexity. International events, changes in naval strategy, base closures, and population growth are among the growing challenges the Navy faces in training its personnel. Realistic at-sea training will become even more important because of the greater sophistication and complexity of combat training and skills. Future joint and combined training will demand that our range complexes and operating areas support new missions and multi-service users. New and emerging threats will require the development and implementation of new technologies, doctrine, tactics, and successful training procedures that will all have to be worked out in, on, and under our training complexes and operating areas. To maintain future capabilities, the Navy will need to optimize the use of its at-sea range complexes and operating areas to provide for the efficient use of these national resources.

With regard to ASW, the Navy must train with active sonars to develop and retain ASW skills. When hunting for submarines, naval forces use many tools. As with every other endeavor, physics puts limits on these tools. The two broad categories of sensors in use today are acoustic and non-acoustic, but the laws of physics are such that acoustic tools are currently much more effective in searching for submarines because sound travels through water much more easily than do non-acoustic emissions like light and radio waves. Hence, all of the primary tools for detecting submarines are acoustic in nature.

Acoustic tools, called sonar, are also classified into two categories: active and passive. Active sonar actually emits sound (a “ping”) into the water. A submarine is detected when this ping bounces off the hull of the vessel and is processed by a receiver. Passive sonar is merely a listening tool – it makes use of sound generated by the submarine itself. Unfortunately, the usefulness of current passive sonar systems has diminished significantly and will continue to do so as submarine technology evolves and submarines become significantly quieter. For example, submarines built today are on average more than a hundred times quieter than those operated by the Soviet Union in the early 1960s. A diesel or air-independent submarine, in certain tactically relevant circumstances, can be virtually undetectable by any passive sonar.

Although submarines control the amount of noise they make, thus controlling their detectability by passive sonar, they cannot easily avoid detection by active sonars (Figure 1-2). Energy-absorbing tiles and hull shaping (analogous to the familiar "stealth" design considerations for aircraft) have been less effective to date in their application to submarines than for aircraft.

Timely and accurate feedback of performance to exercise participants is also crucial with regard to effectively meeting the compressed timeline of training and deployments required by the *Fleet Response Training Plan*. Accurate real-time positional data of participants and their movements provide both safety during the exercise (submarines are most prone to collision with ships when rising to periscope depth before their periscope is in use) and invaluable post-exercise feedback. Training quality is greatly enhanced when real-time feedback is available through proper instrumentation and when results of training operations may be recorded for later playback, enabling expansion and refinement of tactics and procedures.

As noted, the only instrumented range currently available off the east coast of the U.S. is in deep water, requiring that results be extrapolated to apply to the critically different conditions of shallow water, and in some cases requiring exercises to be repeated to validate extrapolated results. In addition, sound propagates differently in deep water than in shallow water. This makes deriving accurate results more complicated. Finally, tactics are different in deep water than they are in shallow water, where depth limitations place different constraints on maneuvering. Given all these considerations, training realistically in shallow water is a clear necessity of modern warfare and homeland protection.

1.4 Preparation of the Final Overseas Environmental Impact Statement/Environmental Impact Statement (OEIS/EIS)

The DoN has prepared this final overseas environmental impact statement/environmental impact statement (OEIS/EIS) to assess the potential environmental effects of installing and operating a USWTR at a location suitable for the Atlantic Fleet. The final OEIS/EIS has been prepared pursuant to:

- National Environmental Policy Act (NEPA) of 1969, which requires a detailed environmental analysis for major federal actions with the potential to significantly affect the quality of the human environment.
- Council on Environmental Quality (CEQ) regulations in 40 Code of Federal Regulations (CFR) Parts 1500 to 1508, which implement the requirements of NEPA.

- Presidential Executive Order (EO) 12114, which requires environmental documentation for *Environmental Effects Abroad of Major Federal Actions*.

- DoD regulations implementing EO 12114: 32 CFR Part 187, *Environmental Effects Abroad of Major Department of Defense Actions*.

- DoN regulations implementing NEPA (32 CFR Part 775).

The OEIS/EIS is also intended to support other environmental reviews associated with implementation of the USWTR, such as:

- Compliance with the Marine Mammal Protection Act (MMPA), 16 USC § 1361 et seq.

- Consultation under Section 7 of the Endangered Species Act (ESA), 16 USC §§ 1531 to 1544.

- Federal consistency determination under provisions of the Coastal Zone Management Act (CZMA), 15 USC §§ 1451 to 1465.

- Compliance with the Rivers and Harbors Act (RHA), 33 USC §§ 401 to 430, 441 to 454.

- Compliance with the Clean Water Act (CWA), 33 USC §§ 1251-1387.

- Performance of essential fish habitat (EFH) analysis under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), 16 USC §§ 1801 to 1882.

- Migratory Bird Treaty Act.

- Executive Order 13089, Coral Reef Protection.

- Executive Order 13158, Marine Protected Areas.

In preparation of this final OEIS/EIS, the DoN considered alternative training concepts and evaluated a series of alternative sites for a USWTR. The USWTR offers exercise realism and training performance feedback to a degree that other alternatives cannot provide. West Coast sites would not be practical for training Atlantic Fleet units because of the extreme transit distance, excessive cost, and time constraints that would be involved with training Atlantic Fleet units on the West Coast. The U.S. Atlantic Coast continental shelf and the operational depth requirements of the USWTR call for siting of the range at least 46 km to 94 km (25 to 50 NM) offshore. Siting of the USWTR approximately 93 km (50 NM) offshore of Jacksonville, Florida,

Comparative Detection Capability of Active and Passive Sonar

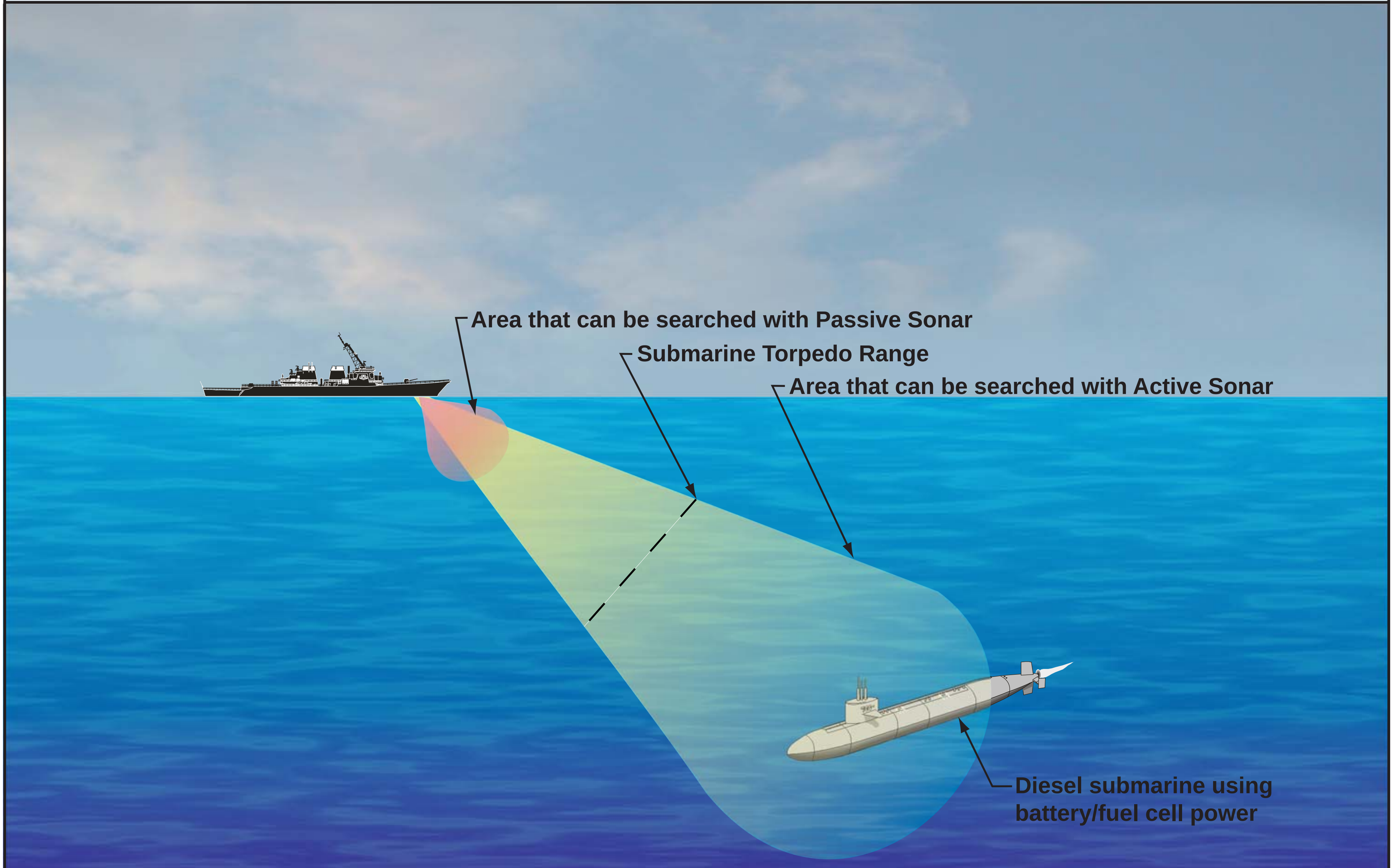


Figure 1-2

is the Navy's preferred alternative, reflecting new operational concerns, revised capabilities, and relocation of Fleet assets that have occurred over the last decade.

1.5 EO 12114 and NEPA

1.5.1 Overview

EO 12114 directs federal agencies to provide for informed decision making for major federal actions with effects that occur outside the 50 states, territories, and possessions of the United States, including marine waters seaward of U.S. territorial seas, the global commons, the environment of a nonparticipating foreign nation, or effects to protected global resources. Global commons are defined as "geographical areas that are outside of the jurisdiction of any nation, and include the oceans outside territorial limits and Antarctica. Global commons do not include contiguous zones and fisheries zones of foreign nations" (32 CFR 187.3). The Navy has published procedures for implementing EO 12114 in OPNAV 5090.1C (DoN, 2007j).

In 1969, Congress enacted the National Environmental Policy Act, or NEPA, the national charter for protection of the environment. The provisions of NEPA apply to major federal actions with effects that occur within U.S. territory. The President's Council on Environmental Quality (CEQ) established regulations for federal agency implementation of NEPA.

Under NEPA, all branches of the federal government must prepare an EIS before undertaking any major action or actions that may significantly affect the quality of the human or natural environments. One agency, the action proponent, is the lead agency. Often other agencies that have jurisdiction by law or special expertise with respect to certain potential environmental impacts from the proposed action participate as "cooperating agencies."

The proposed action, establishment of a shallow water training range off the east coast of the U.S., requires assessment of impacts both outside U.S. territory and within. In this case, because NEPA is required, the Navy is conducting a full NEPA assessment as well as an analysis under EO 12114, and for that reason, the NEPA process is described in detail in the following text. This document is being produced as a final OEIS/EIS under the authorities of both regulations. *In Chapters 3 through 6 of this final OEIS/EIS, text that describes the effects that occur within U.S. territory – effects that are subject to NEPA analysis – is in italicized font.* Text that pertains to effects relating to EO 12114 is not italicized.

1.5.2 The NEPA Process

Under NEPA, an EIS must disclose significant environmental impacts and inform decision makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the environment. The first step in the NEPA process for preparation of an EIS is to prepare a notice of intent (NOI) to develop the EIS and publish the notice in the *Federal Register*. The NOI provides an overview of the proposed project and the scope of the EIS.

After the NOI is published, a “scoping period” occurs. (Unlike NEPA, EO 12114 does not require a scoping process.) Scoping is an early and open process during which the public and other agencies review the project and provide input to help develop the “scope” of issues to be addressed in the EIS and to identify significant issues related to a proposed action. Public scoping meetings are typically held during this time. The period for public comment is generally 45 to 60 days in length. Comments are conveyed to the agency at the meetings and in writing after the meetings until the close of the comment period.

After considering comments received during scoping, a draft EIS (DEIS) is prepared that provides an assessment of the potential impacts of the proposed federal action. The DEIS informs decision makers and the public of reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the environment. A “no action” alternative is always evaluated in an EIS to serve as a baseline for comparison with the proposed action alternatives.

When the document is completed, the DEIS review period begins. At that time, a notice of availability (NOA) of the document is placed in local newspapers and in the *Federal Register.* Copies are distributed to government agencies, interested citizens, and organizations for review and comment, and public hearings are also held during this period. A final EIS (FEIS) that incorporates and responds to all public comment on the DEIS is then prepared.

The FEIS contains a responsiveness summary, wherein the lead agency addresses comments received on the DEIS. Responses can take the form of corrections of data inaccuracies, clarifications of and modifications to analytical approaches, inclusion of additional data or analyses, and modification of the alternatives. After the release of the FEIS and the publication of the Notice of Availability, there is a 30 day wait period. After the 30 day wait period, the Record of Decision (ROD) can be signed, implementing the proposed action. The ROD establishes the proposed action, describes the public involvement and agency decision-making process, and presents the commitments to mitigation measures. The proposed action can then be implemented.

1.5.3 OEIS/EIS for the USWTR

The DoN is the lead agency for the proposed USWTR, with National Oceanic and Atmospheric Administration’s (NOAA) National Marine Fisheries Service (NMFS) acting as a cooperating agency. The NOI for this project was published in the *Federal Register* on May 13, 1996, initiating the NEPA EIS process. Because the proposed USWTR is a major federal action with potential impact outside the U.S. as well as within the U.S., this EIS has been developed pursuant to both EO 12114 (see Subchapter 1.5.1) and NEPA regulations.

The USEPA published the NOA of the draft OEIS/EIS for the proposed USWTR in the *Federal Register* on October 28, 2005. In November 2005, the Navy held informational meetings combined with public hearings in Chincoteague, Virginia; Morehead City, North Carolina; and Jacksonville, Florida. The public comment period for the draft OEIS/EIS ended January 30, 2006.

Subsequently, the DoN decided that a revised draft OEIS/EIS should be prepared based on comments received during the public comment period, changes in technology that obviated the need for a secure landside cable termination facility (CTF), and changes in the methodology by which behavioral impacts to marine mammals are assessed.

The Navy published the NOI to prepare the revised draft OEIS/EIS and to open another scoping comment period in the *Federal Register* on September 21, 2007. Comments received on the September 12, 2008 draft OEIS/EIS have been addressed in Appendix H of this final OEIS/EIS. Public comments and responses are available electronically on the USWTR public Web site (http://www.projects.earthtech.com/USWTR). The ROD for the USWTR is scheduled for issuance in summer 2009. More details concerning the public review process are available in Chapter 7.

1.6 Other Environmental Requirements Considered

Construction and operation of the USWTR must be consistent with a variety of laws and regulations. The following subchapters provide a brief description of the principal environmental requirements that are relevant to the USWTR project.

1.6.1 Marine Mammal Protection Act (MMPA)

The MMPA of 1972 established, with limited exceptions, a moratorium on the "taking" of marine mammals by citizens of the United States. The term "take," as defined in Section 3 (16 USC 1362) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, which provided two levels of "harassment," Level A (potential injury) and Level B (potential disturbance).

The National Defense Authorization Act (NDAA) of fiscal year (FY) 2004 (Public Law [PL] 108-136) amended the definition of harassment as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with Section 104(c)(3) [16 USC 1374 (c)(3)]. The FY 2004 NDAA adopted the definition of "military readiness activity" as set forth in the FY 2003 NDAA (PL 107-314). For military readiness activities the relevant definition of harassment is any act that:

- Injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (“Level A harassment”), or

- Disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing 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 (“Level B harassment”) [16 USC 1362 (18)(B)(i)(ii)].

The use of USWTR constitutes a military readiness activity as that term is defined in PL 107-314. Because the proposed use of the USWTR to conduct ASW training constitutes “training and operations of the Armed Forces that relate to combat” and constitutes “adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use” it is consistent with the NDAA.

Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing), if certain findings are made and regulations are issued. Authorization will be granted by the Secretary for the incidental take of marine mammals if the taking will have a negligible impact on the species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

As part of the environmental documentation for the proposed USWTR, the Navy will apply for a permit to harass marine mammals, referred to as a take authorization or letter of authorization (LOA). LOAs require that regulations be promulgated and published in the *Federal Register* outlining:

- Requirements pertaining to the monitoring and reporting of such taking.

- Permissible methods of taking and the means of affecting the “least practicable adverse impact” on the species or stock and its habitat.

- For military readiness activities, a determination of “least practicable adverse impacts” on species or stock that includes consideration, in consultation with the DoD, of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

In accordance with the Letter of Authorization (LOA) procedures, the Navy will submit an application to NMFS, requesting authorization pursuant to Section 101 (a)(5)(A) of the MMPA to incidentally take marine mammals by harassment. When the application is received by NMFS, a notice of receipt of application is published in the *Federal Register*. Publication of the notice initiates a 30-day public comment period, during which time anyone can obtain a copy of the application by contacting NMFS. The Navy will obtain the LOA before conducting ASW training operations on the range.

1.6.2 Endangered Species Act (ESA)

The ESA (16 USC 1531 to 1543) applies to federal actions in two separate respects. First, the ESA requires that federal agencies, in consultation with the responsible wildlife agency, ensure that proposed actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat [16 USC 1536 (a)(2)]. Regulations implementing the ESA expand the consultation requirement to include those actions that "may affect" a listed species or adversely modify critical habitat.

Second, if an agency's proposed action would take a listed species, then the agency must obtain an incidental take statement from the responsible wildlife agency. The ESA defines the term "take" to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any such conduct" [16 USC 1532(19)].

The Navy is consulting with NMFS on effects the construction and operation of the proposed USWTR may have on listed species. The Navy will consult with the USFWS on the effects of the proposed construction of the trunk cable and CTF on listed species.

1.6.3 Coastal Zone Management Act (CZMA)

The CZMA provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs for the coastal zone. This includes the protection of natural resources and management of coastal development. The respective state coastal zone management program implements policy. The CZMA requires that any federal agency activity that is reasonably foreseeable within or outside the coastal zone and affects any land or water use or natural resource of the coastal zone be carried out in a manner that is consistent, to the maximum extent practicable, with the enforceable policies of NOAA-approved state management programs.

For the proposed USWTR, pursuant to the CZMA, the Navy must determine whether USWTR construction and operation activities are reasonably anticipated to affect any coastal use or resources and if so, shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved state management programs.

1.6.4 Rivers and Harbors Act (RHA)

The RHA was enacted to ensure that navigable waters are not obstructed or fouled by the placement of material or disposal of refuse in them. Under Section 10 of the RHA, 33 USC §403, a U.S. Army Corps of Engineers (USACE) permit is required for structures and/or work in or affecting navigable waters of the U.S. The RHA governs the placement of the cable for the USWTR. Before proceeding with placement of cable and nodes of the USWTR, the Navy will coordinate with the USACE as necessary.

1.6.5 Clean Water Act (CWA)

The Clean Water Act (CWA) was enacted to protect surface water quality in the United States. Under Section 404 of the CWA, 33 USC §1344, a USACE permit is required for the placement of dredged or fill material in waters of the U.S. Under Section 401 of the CWA, 33 USC §1341, the state where dredged or fill material would be placed in waters of the U.S. must certify that the action would not contravene the state's water quality standards. The CWA governs the placement of the cable for the USWTR. Before proceeding with construction of the USWTR, the Navy will coordinate with the USACE and the appropriate state agency as necessary.

1.6.6 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act, enacted to conserve and restore the nation's fisheries, includes a requirement for NMFS and regional fishery councils to describe and identify essential fish habitat (EFH) for all species that are federally managed. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Under the act, federal agencies must consult with the Secretary of Commerce regarding any activity or proposed activity that is authorized, funded, or undertaken by the agency that may adversely affect EFH.

An assessment of potential impacts of the project to EFH has been prepared and submitted to NMFS; consultation is being conducted.

1.6.7 Migratory Bird Treaty Act (MBTA)

The MBTA was enacted to ensure the protection of bird resources that migrate between the United States and Canada, Mexico, Japan, or the Russian Federation. A migratory bird is any species of birds that lives, reproduces, or migrates within or across international borders at some point during its annual life cycle. The MBTA protects 836 bird species, 58 of which are currently legally hunted as game birds. The list of species protected by the MBTA appears in 50 CFR 10.13.

The MBTA prohibits the take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit (16 USC 703). The regulations at 50 CFR 21.11 prohibit the take of migratory birds except under a valid permit or as permitted in the implementing regulations. A "take" is defined to mean to "pursue, hunt, shoot, wound, kill, trap, capture, or collect" or to attempt these activities (50 CFR 10.12).

On February 28, 2007, the Department of Interior (DoI) issued final regulations that authorize the take of migratory bird resources incidental to military readiness activities (50 CFR 21.15). The definition of military readiness activities includes all training and operations of the Armed Forces that relate to combat, and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use (50 CFR Part 21.3).

The proposed USWTR meets the definition of military readiness activities. These regulations require that, if the ongoing or proposed military readiness activities may result in a significant adverse effect on a population of a migratory bird species, the Armed Forces must confer and cooperate with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate the anticipated significant adverse effects.

1.6.8 Abandoned Shipwreck Act (ASA)

The ASA (43 USC 2101-2106) was enacted in 1988 and establishes government ownership over the majority of abandoned shipwrecks located in waters of the U.S. and creates a framework within which shipwrecks are managed. It affirms the authority of state governments to claim and manage abandoned shipwrecks on state submerged lands.

Shipwrecks are identified as resources having multiple values and uses that are not to be set aside for any one purpose or interest group. This includes recreational and educational opportunities for sport divers and fishermen, historical values important to archaeologists and historic preservationists, and habitat areas for marine life. In addition, shipwrecks may generate tourism and other forms of commerce and contain valuable cargoes and objects of interest to commercial salvors and treasure-hunters.

States are directed to provide reasonable access by the public, protect natural resources and habitat areas, guarantee recreational exploration of shipwreck sites, and allow appropriate public and private sector recovery when the shipwreck's historical values and surrounding environment are protected. In addition, states are encouraged to create underwater parks to provide additional protection for shipwrecks. States are authorized to use federal funds from the Historic Preservation Fund grants program to study, interpret, protect, and preserve historic shipwrecks.

1.6.9 Sunken Military Craft Act (SMCA)

The SMCA (10 USC § 113) was enacted on October 28, 2004. The new law confirms that sunken U.S. military vessels and aircraft are the sovereign property of the United States regardless of the passage of time and provides for archeological research permits and civil enforcement measures (including substantial fines) to prevent unauthorized disturbance. The law of salvage does not apply to sunken military craft without the express permission of the sovereign (U.S. or foreign flag). The SMCA provides the United States with a new authority for protecting and preserving sunken warships, naval auxiliaries, other vessels, military aircraft, and military spacecraft that was owned or operated by a government when it sank, and the associated contents of such craft.

The statute provides the following:

- Protection of sunken U.S. military ship and aircraft wherever located.
- Protection for the graves of lost military personnel.
- Protection of sensitive archaeological artifacts and historical information.
- Codifies existing case law, which supports federal ownership of sunken U.S. military ship and aircraft wrecks.
- Provides a mechanism for permitting and civil enforcement to prevent unauthorized disturbance.
- Encourages the Secretary of State, in consultation with the Secretary of Defense, to enter into bilateral and multilateral agreements with foreign countries for the protection of sunken military craft.
- Does not affect salvage of commercial merchant shipwrecks, or recreational diving.
- Does not impact commercial fishing, or the laying of submarine cables.
- Does not relate to the routine operation of ships.

1.6.10 Executive Order 13089

EO 13089, *Coral Reef Protection*, directs federal agencies to ensure that any actions they authorize, fund, or carry out will not degrade the biodiversity, health, heritage, and social and economic value of coral reef ecosystems and the marine environment. For federal agency actions that would affect U.S. coral reef ecosystems, subject to the availability of funding, measures should be implemented to research, monitor, manage and restore affected ecosystems. These measures should include reducing impacts from pollution, sedimentation, and fishing.

1.6.11 Executive Order 13158

EO 13158, *Marine Protected Areas*, directs federal agencies to protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs). An expanded and strengthened comprehensive system of marine protected areas throughout the marine environment would enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. Federal agencies should avoid causing harm to MPAs through federally conducted, approved, or funded activities.

1.6.12 Cooperating Agencies

CEQ's NEPA implementing regulations allow federal agencies (as lead agencies) to invite tribal, state, and local governments, as well as other federal agencies, to serve as cooperating agencies in the preparation of EISs. The lead agency maintains the responsibility of supervising the development of the EIS, which addresses the potential effects associated with activities connected to the Proposed Action.

Upon request of the lead agency, any other federal agency that has jurisdiction can serve as a cooperating agency. In addition, any other federal agency with special expertise on any environmental issue that should be addressed in the EIS may serve as a cooperating agency upon request of the lead agency. The cooperating agency, upon request by the lead agency, is responsible for assisting in the development of information and preparing environmental analyses associated with the agency's area of expertise.

The Navy requested that NMFS participate as a cooperating agency in the preparation of this OEIS/EIS; NMFS has agreed to a cooperating agency status. Copies of these letters are contained in Appendix G. NMFS is a cooperating agency primarily because of its responsibilities pursuant to Section 101(a)(5)(A) of the MMPA and Section 7 of the ESA.

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2 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

The proposed action is to instrument a 1,713-km^2 (500-NM^2) area of the ocean with undersea cables and sensor nodes and to use the area for ASW training. This training would typically involve up to three vessels and two aircraft using the range for any one training event. The instrumented area would be connected to the shore by cable. The proposed action would require logistical support for ASW training, including training with a variety of non-explosive exercise weapons, target submarine simulators, and other associated hardware.

After identifying the need for a USWTR offshore of the east coast of the United States, the Navy defined the operational subcriteria required for the range. The next step was to develop a set of alternatives that would address those subcriteria and meet the overall purpose and need of the proposed action described in Chapter 1. Implementation of the USWTR in the Jacksonville (JAX) Operating Area (OPAREA), approximately 93 km (50 NM) offshore of northeastern Florida, is the Navy's preferred alternative.

This chapter is comprised of five subchapters containing:

- a discussion of training concepts considered but eliminated from further analysis in this final OEIS/EIS, such as use of deep-water ranges, a portable underwater tracking range (PUTR) system, and simulators (2.1).

- a detailed description of the proposed action, including proposed training range usage and typical training scenarios (2.2).

- a description of the site selection process and a summary of the evaluation results for the candidate sites (2.3).

- a description of the process by which the preferred alternative was identified (2.4).

- a discussion of the four alternative USWTR site locations analyzed in this final OEIS/EIS, and a description of the No Action Alternative (2.5).

2.1 Alternative Training Concepts Considered but Eliminated from Further Analysis

The cornerstones of effective training are conditions that mirror realistic combat scenarios and provide timely feedback of training performance to the participating units. For ASW training, current capabilities that replicate realistic combat scenarios require the use of sensors, including tactical military sonars, and the firing of non-explosive exercise weapons at both submarines and mobile targets that simulate submarines. At the same time, the Navy must provide for safety, command and control, informational feedback, and the recovery of reusable systems. This is best achieved at an instrumented range facility established specifically for training.

Instrumented training ranges have been used since the 1960s to aid in the safety, operational conduct, and recording of training exercises. They also allow shore-based operators to evaluate performance of participants in a variety of training scenarios and, through replay, to provide feedback to participants. This feedback is essential to development of effective ASW weapons, tactics, and procedures. Currently, however, the Navy's existing instrumented undersea warfare ranges do not meet the requirements for training in shallow water coastal environments.

Several alternative training concepts were considered in terms of addressing these requirements but were eliminated from further consideration for various reasons. These alternatives included existing east coast instrumented ranges used for training, portable underwater tracking ranges (PUTRs), and computer-based simulation training for the shallow water environment, discussed below:

- Existing East Coast Instrumented Ranges

  One existing undersea tracking range currently supports tactical training for the Atlantic Fleet: the Atlantic Undersea Test and Evaluation Center (AUTEC) near the Bahamas. AUTEC is a deep-water range, greater than 914 m (3,000 ft) deep. The ocean environs around AUTEC and the Berry Islands do not include broad operating regions within the water depths of interest for USWTR. The region is characterized by broad plateaus of water at depths less than 30 m (100 ft), with steep transition zones to the ocean's bottom, and therefore do not meet litoral ASW training requirements.

  - These regions do not provide a reasonable distribution of operating depths and encompass only a narrow band along the transition zone.

  - This narrow band is not representative of likely threat environments and is insufficient as a shallow water training area.

  - Deep-water ranges cannot realistically simulate the shallow water acoustic environment. In deep-water acoustic environments, the propagation path of sound energy does not result in much interaction with the ocean's surface or bottom. In shallow water, the sound energy does interact greatly with the ocean's surface and bottom, making shallow water a more complex acoustic environment.

- This location does not have sufficient shallow water areas adjacent to it to allow feasible expansion.

- Portable Underwater Tracking Range (PUTR)

  A PUTR system was developed for use in test and evaluation (T&E) exercises and is also used for training of naval forces deployed overseas. The largest existing PUTR system, consisting of 100 sensor nodes, can only support an area limited to approximately 343 km^2 (100 NM^2), far less than that required for the proposed USWTR operations. Other variations of this type of range are smaller still. PUTR does not provide the necessary communications capability to support the acoustic command link (ACL) for submarine target control, a submarine warning system to ensure safety when multiple submarines are present in a training event, or full range coverage for voice communications. As a result, this type of range cannot support all training platforms and training scenarios required to operate at the proposed USWTR. For example:

  – Operational tempo for portable systems is limited by battery life. For the USWTR operational profiles of approximately 1,600 hours per year, the PUTR battery bank would need to be expanded tenfold to accommodate a single year's training. Increasing the battery bank size would drive the instrumentation's size and weight from a few hundred pounds to approximately one thousand pounds. This in turn negatively impacts the logistics for installation and recovery, including the size and capacity of the installation vessel to handle the increased weight.

  – PUTR hardware performance in terms of data communications, ACL functions, sub-warn systems, and voice communications is degraded in comparison to performance on fixed ranges; with a PUTR, the long-haul (tens of miles), high fidelity (less than 1 per billion bit error rate), high capacity (100s of megabits/sec) capability of fiber optics must be replaced by less capable or more complex data links such as acoustic modems (few miles underwater, few kilobits/second), radio channels (line of sight transmission) or satellite links. These systems are limited in their ability to originate and receive communications from a common point for processing, display and control functions. This results in the need for numerous surface platforms (buoys, ships, or remote vehicles) to act as repeaters or relays to the range operational center and restricts the overall range size.

– Operational availability with a portable system can be impacted by environmental conditions, especially wave height, during the recovery, deployment, and calibration of a portable system. For safety to personnel and equipment, these operations must be conducted in periods of reasonable weather conditions. Rough weather can force delays to system installation or recovery operations. Also, to ensure permanent range capability for the year-round training operations, two complete systems would be required, with one in use and one undergoing refurbishment. Each installation cycle requires a period of several days to deploy, calibrate, and certify the system prior to training exercises. Similarly, a portable system is dependent on a surface vessel to host the range operations center and multiple surface platforms to act as communications relays. These items all create additional operating costs and have potential weather limitations that would restrict training. Size limitations on portable systems complicate, or may prevent, the ability to train on portions of the range distant from any marine mammal which may be on the range.

- Computer-Based Simulation Training

  Conducting all activities through simulation does not meet the operational requirements of realistic training. Initial training of sonar technicians does occur using simulators; simulators are usually the first means of training in the basics of sonar system operations. However, there are several reasons that simulators will not, in the foreseeable future, replace real-world training:

  - Simulators cannot match the dynamics encountered in the ocean environment. Specifically, computer modeling simulations cannot adequately mimic the bathymetry, sound propagation properties, or oceanography to the degree necessary to serve as a complete substitute for actual at-sea sonar operations. Navy personnel require real-time training with active sonar to understand bottom bounce and multiple propagation path environmental conditions and the effects of mutual sonar interference.

  - Computer simulation cannot replicate the complexities of conducting coordinated ASW in at-sea combat. Individual ships are expected to integrate their ASW operations with other ships operating active sonar, defend the air space in their operating area from aircraft firing missiles at aircraft carriers or amphibious ships, and defend against other surface combatants. Real-time experience with interplay between ship and submarine target and between ASW teams in the strike group is critical. For instance, coordinated unit level training (ULT) and strike group training activities require multiple crews to interact in a variety of acoustic environments; this cannot be simulated.

- The majority of research, development, test, and evaluation activities cannot be reliably executed using computer simulation; these must be conducted in actual acoustic environments to ensure the ultimate safe and effective use of the active sonar system.

- Simulators, as good as they are, cannot adequately replicate conditions in the world's shallow water areas where Navy forces could operate. The Navy continues to research new ways to provide realistic training, but there is currently no effective simulated training for certain active sonar activities.

In sum, there is an inescapable requirement to train actively in authentic environmental conditions, with actual Navy acoustic equipment. As indicated in Chapter 1, Section 5062 of Title 10 USC contains a legal mandate for such training as would be provided by the proposed range. Title 10 directs the Chief of Naval Operations (CNO) to organize, train, and equip all naval forces for combat. Deep-water ranges, portable underwater tracking range systems, and computer simulators have significant shortcomings. Because these alternative training options do not meet the purpose and need for the proposed action, they were eliminated from further analysis.

2.2 Proposed Action

2.2.1 Range Installation

The USWTR instrumentation is a system of underwater acoustic transducer devices, called nodes, connected by cable to each other and to a landside facility where the collected range data are used to evaluate the performance of participants in shallow water training exercises (Figure 2-1). These transducer nodes are capable of both transmitting and receiving acoustic signals from ships operating within the USWTR (a transducer is an instrument that converts one form of energy into another; e.g., a sound into an electrical signal, as in a telephone). The acoustic signals that are sent from the exercise participants to the range nodes allow the position of the participants to be determined and stored electronically for both real-time and future evaluation. More specifically:

- The USWTR would consist of no more than 300 transducer nodes spread on the ocean floor over a 1,713-km^2 (500-NM^2) area. The distance between nodes would vary from 2 to 6 km (1 to 3 NM), depending on water depth. A junction box would connect the cables on the range with a trunk cable that would connect to a cable termination facility (CTF) on the shore.

- The transducer nodes would be either dome-shaped (Figure 2-2) or tethered (Figure 2-3). The overall shape and configuration would be designed to be consistent with local conditions and to accommodate activities in the area, such as fishing. The installation of each of the 300 nodes would impact an area of about 10 m^2 (107.6 ft^2); the nodes would lie on the ocean floor. The total impact area for the installation of all of the nodes would be about 3,000 m^2 (32,300 ft^2); this is about 0.000002 percent of the area of the range.

- When a node is installed, the installation ship would reduce speed or stop to maneuver the device into the water and onto the ocean bottom. The ship would then resume the cable installation until the full system had been set in place. Throughout the installation, observers would be located on both the deck and bridge of the ship to monitor the progress and equipment. Underwater observations would not be made of the cable or nodes during installation but electronic monitoring of their operation would be performed.

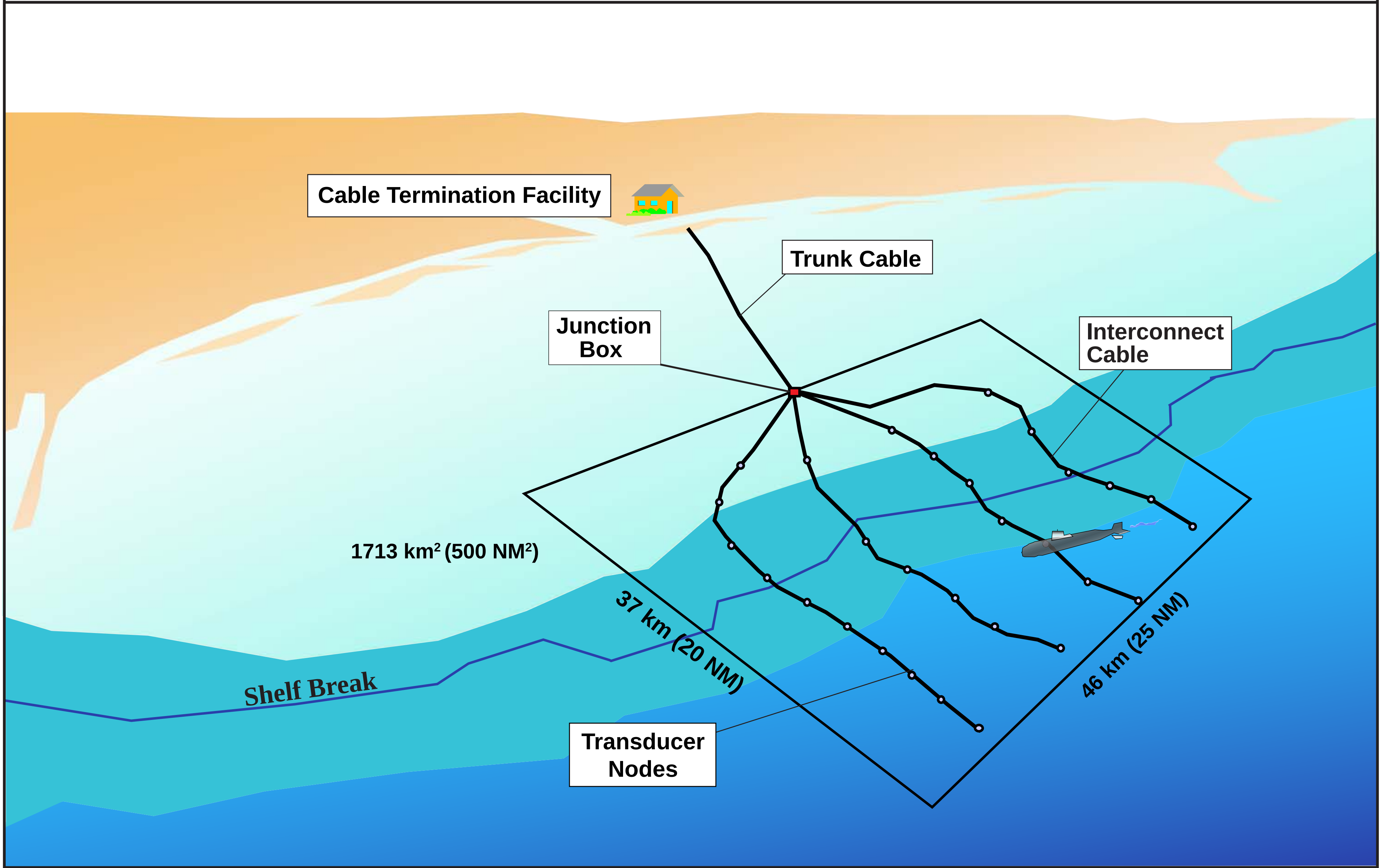
- The nodes would be connected with commercial fiber optic undersea cable (approximately 2.5 cm [0.98 in] in diameter), similar to that used by the telecommunications industry. Approximately 1,110 km (600 NM) of cable would be used to connect the nodes.

- The USWTR cable installation would use equipment and techniques commonly used by the telecommunications industry for phone and data cables. The installation ship would proceed slowly (1 to 3.7 km/hr [0.5 to 2 NM/hr]) along the desired cable route. Based on this speed, the ship would install 1 km (0.54 NM) of cable in as little as 16 minutes or as much as 60 minutes. If the interconnect cable is not buried, the area impacted by the cable would be 27,500 m^2 (295,900 ft^2); this is about 0.00002 percent of the area of the range.

- The interconnect cables that are not buried are intended to lie on the ocean bottom. Cable suspensions (i.e., cable extending above the ocean bottom) are avoided through the system design and installation process. Cable suspensions can cause a cable to fail over a period of time due to bending or abrasion. Cable routes are specifically selected to avoid, if possible, ocean bottom areas with significant ridges, valleys, or rock fields, in order to minimize the potential for suspensions. The cable is also installed with an excess length of cable ('slack'), typically 3 to 5 percent, to insure that the cable is not stretched taut over bottom relief, but is able to settle to the ocean bottom.

- The interconnect cable between each node would be buried, if deemed necessary, using a tracked, remotely operated cable burial vehicle. The decision to bury the cable would be based on activities that interact with the bottom, such as anchoring and extensive use of bottom-dragged fishing gear. If the interconnect cable is

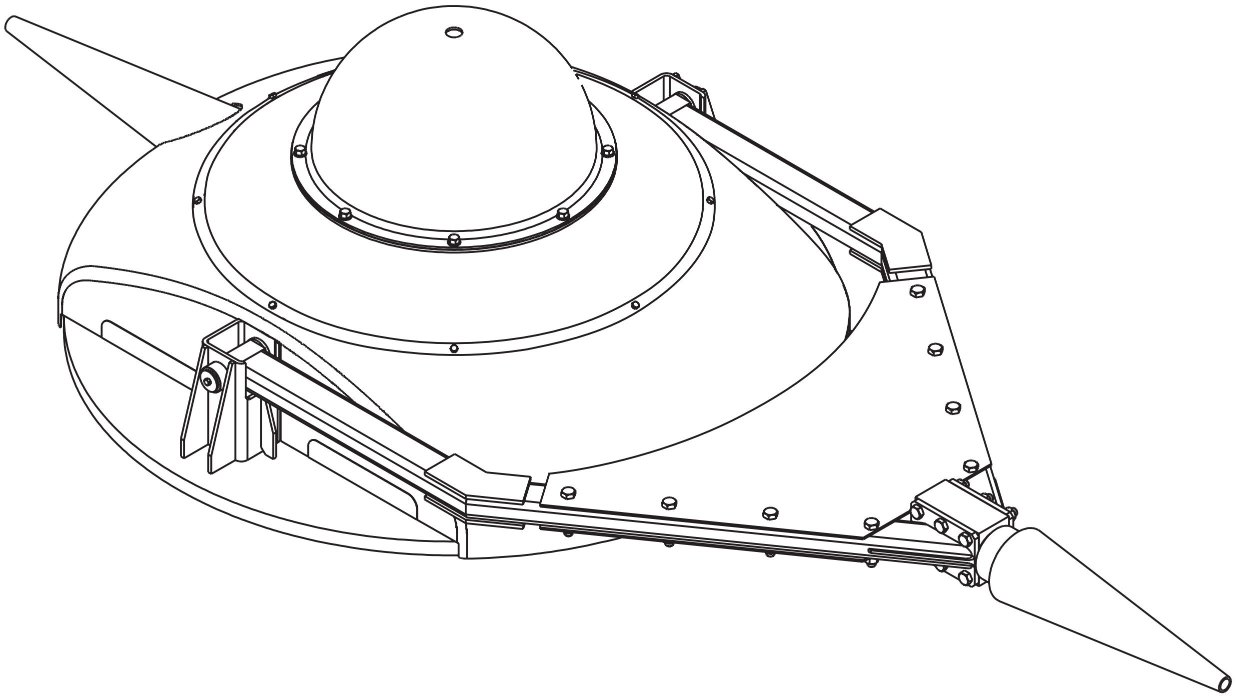
USWTR Range Concept



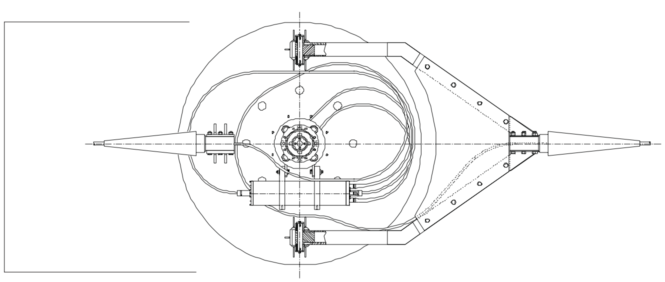
Not to Scale

Figure 2-1

Dome-Shaped USWTR Transducer Node



Diameter = up to 254 cm (100 in)



Height = up to 122 cm (48 in)

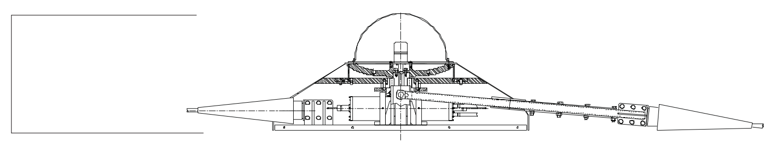


Figure 2-2

Tethered Sensor Node Without Protective Structure

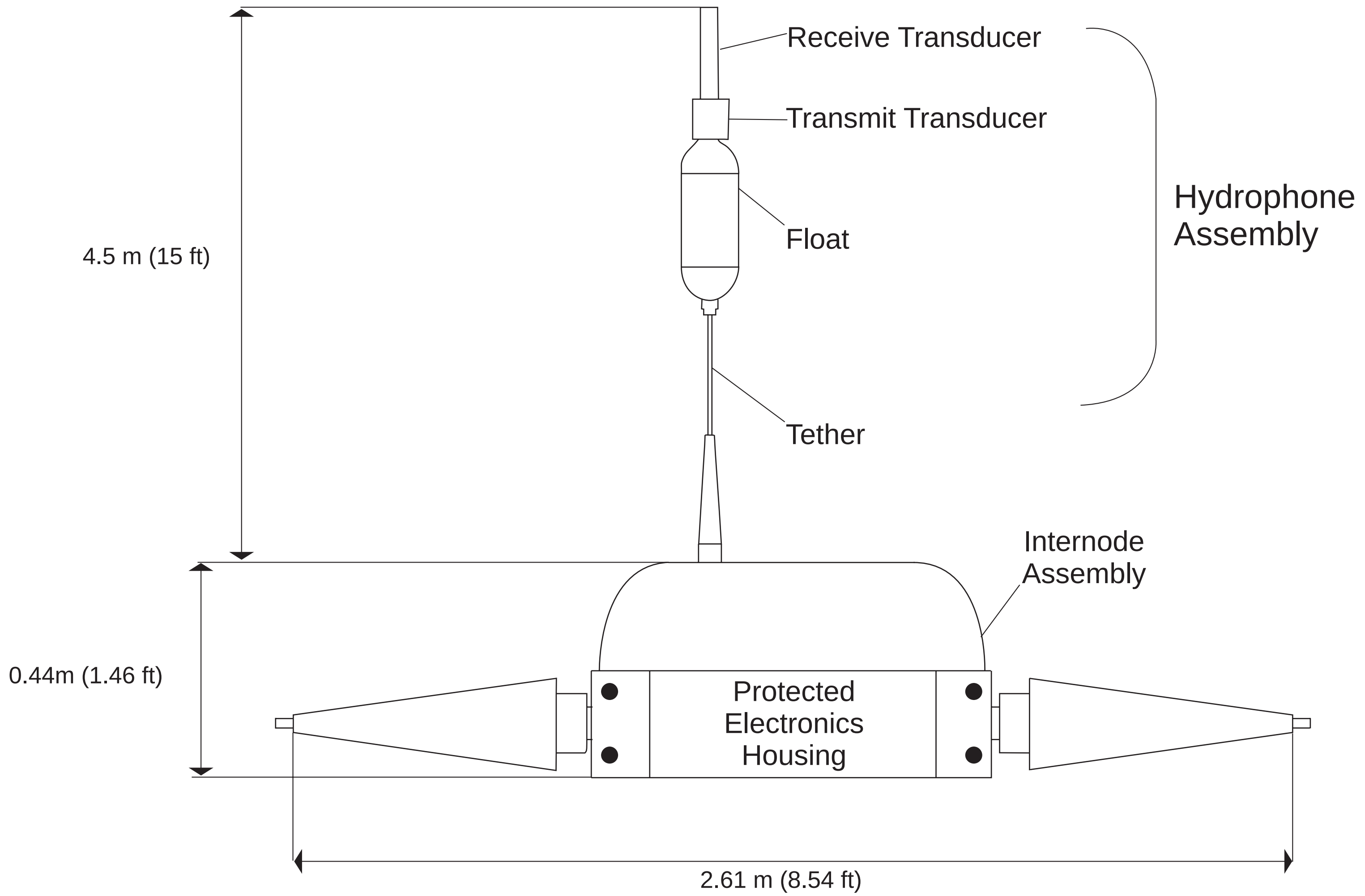


Figure 2-3

buried, the area impacted by the cable installation would be about 5,500,000 m^2 (59,180,000 ft^2).

- Trenching equipment would be used in hard bottom areas to cut a furrow approximately 10 cm (0.3 ft) wide and about 90 cm (3 ft) deep, into which the cable would be placed. The cable installation process would involve the excavation of pieces of hard substrate that are pushed aside by the cutter head in the immediate surrounding area of the furrow. In soft sediment, the cable would be buried about 90 cm (3 ft) deep using jetting or a plow. In jetting, the soil is "liquefied" by the jetting process and then dispersed into the water column. In a short period of time, the fine sediment would then settle back to the ocean bottom. The plowing process is similar to trenching, except the plow uses the newly disturbed sediment as a backfill to cover the trench. Modern equipment for trenching, jetting, and plowing is designed to minimize disturbance of the ocean bottom.

- The risk of harming benthic organisms during the installation of the cables and nodes would be minimized by thoroughly surveying the area prior to the burial process. The survey would use multi-beam sonar to collect information such as bathymetry, seabed morphology at scales of 1.6 to 33 ft (0.5 to 10 m), sediment types, and surface geology. This information would be coupled with photographs of the ocean bottom and biological/geological samples to provide accurate data on the location of existing habitats.

- A junction box located at the edge of the range would connect the interconnect cables with the trunk cable. Installation of the junction box would impact an area of about 30 m^2 (523 ft^2).

- A buried trunk cable would connect the CTF to the junction box. The trunk cable would be about 100 km (62 mi) in length and approximately 3 to 6 cm (1 to 3 in) in diameter. From the CTF, the trunk cable would be buried in an excavated trench to a point just upland of either sand dunes or an impassable physical feature (such as a highway). The trunk cable would then run through an underground conduit, which would be installed by horizontal directional drilling. The conduit would extend from the end of the trench, underneath the dunes, beach, and shoreline, to a point approximately 915 m (3,000 ft) offshore of the mean low water line. The offshore exit point of the conduit may be secured to the ocean bottom with an anchor.

- From the conduit exit point to the junction box, the cable would be buried to a depth of 0.5 to 1 m (1 to 3 ft) in a trench 10 cm (4 in) wide. The trench would be excavated by a tracked, remotely operated cable burial vehicle that is approximately 5 m (16 ft) in width. Installation of the trunk cable would impact about 500,000 m^2 (5,380,000 ft^2) of the ocean bottom.

- The total impacts of the installation of the range are presented in Table 2-1. If the interconnect cables are buried, the total impact to the ocean bottom would be 5,500,000 m^2 (59,180,000 ft^2); this is about 0.003 percent of the area of the range. If the interconnect cables are not buried, the total impact to the ocean bottom would be 27,500 m^2 (295,900 ft^2); this is about 0.00002 percent of the area of the range.

Table 2-1

Impacts of Range Installation to Ocean Bottom

Installation Method	Interconnect Cables	Nodes	Junction Box	Trunk Cable	Total Area
Interconnect Cables Buried	5,500,000 m^2 59,180,000 ft^2	3,000 m^2 32,300 ft^2	30 m^2 323 ft^2	500,000 m^2 5,380,000 ft^2	5,508,030 m^2 59,266,400 ft^2
Interconnect Cables Not Buried	27,500 m^2 295,900 ft^2	3,000 m^2 32,300 ft^2	30 m^2 323 ft^2	500,000 m^2 5,380,000 ft^2	530,500 m^2 5,708,500 ft^2

- The CTF would be an approximately 37-m^2 (400-ft^2) structure that would house the power supplies, system electronics, and communications gear necessary to operate the offshore range. From there, information gathered on the USWTR would be transmitted via either a military or commercial data link to the Range Operations Center, where the exercise control would be coordinated.

- The USWTR is designed to achieve a long operating life of 20 years, with a minimum need for maintenance and repair. This is due to the high cost of performing at-sea repairs on transducer nodes or cables, the long lead time to plan and conduct such repairs (often six months or more), and the loss of the training range until the repairs are made. The long-life performance is achieved by implementing multiple levels of redundancy in the system design, to include back up capacity to key electronic components, fault tolerance to the loss of individual sensors, and overlap in the detection areas for individual tracking sensors. The use of materials capable of withstanding long-term exposure to high water pressure and salt water-induced corrosion is also important. Cables may be periodically inspected by divers or undersea vehicles to ensure they remain buried and to monitor the recovery of the areas that have been disturbed.

- When the range instrumentation is no longer necessary, it will be left in place. Removal of cables and nodes would likely cause an adverse impact on the environment. The CTF building will be re-used as appropriate.

The FACSFAC JAX would submit cable area coordinates to the National GeoSpatial-Intelligence Agency and NOAA and request that the USWTR area be noted on charts within the appropriate area. This area would be noted in the *U.S. Coast Pilot* as a military operating area, as are other areas on the east coast. The Navy will broadcast a notice to mariners and a notice to airmen within 72 hours of the training activities, as appropriate. The Navy also will establish a local outreach program that could include such avenues of communication as a Web site; USCG radio; state programs to communicate with divers and commercial and recreational fishers; and regular communications with the community.

Construction would be completed in one to three phases based on the manner in which funding is made available. If completed in three phases, the first phase would encompass a minimum of 686 km^2 (200 NM^2), followed by a second phase of 686 km^2 (200 NM^2), and a final phase of 343 km^2 (100 NM^2). A two-phase installation is also possible. If the range were built in phases, there would be an approximate three-year wait between the construction of each phase. Should the Navy determine that a single installation phase is appropriate, the OEIS/EIS reflects the anticipated effects of the entire operational capability. Construction would take approximately 6 to 12 months per phase. The preferred in-water construction period is spring through fall.

2.2.2 Training Range Usage

The principal type of exercise conducted on the USWTR would be ASW. A wide range of ships, submarines, aircraft, non-explosive exercise weapons, and other training-related devices are used for ASW training. Submarines, surface ships, and aircraft all conduct ASW and would be the principal users of the range. The requirements of threat realism on the USWTR necessitate training with a variety of sensors, non-explosive exercise weapons, target submarine simulators, and other associated hardware. Many of the materials used on the USWTR would be recovered after use; however, some would be left in place (see Subchapter 4.8.7). All ordnance used would be non-explosive.

2.2.2.1 Antisubmarine Warfare

Either individually or as a coordinated force, submarines, surface ships, and aircraft conduct ASW against submarine targets. Submarine targets include both actual submarines and other mobile targets that simulate the operations and signature characteristics of an actual submarine. ASW exercises are complex and highly variable. These exercises have been grouped into the four representative scenarios described below in order to best characterize them for environmental impact analysis purposes. Additional details regarding the four training scenarios are summarized in Table 2-2. Table 2-3 provides a list of the platforms, sensors, non-explosive exercise weapons, target submarine simulators, and many other associated hardware employed in each scenario.

- **Scenario 1: One Aircraft vs. One Submarine** (Figure 2-4). The range operations center gives an aircraft (helicopter or fixed-wing) the approximate, or “last known,” location of the submarine. An aircraft flies over the range area and the crew conducts a localized search for a target submarine using available sensors. After the aircrew detects the submarine, it simulates an attack. Each exercise period typically involves the firing of one exercise torpedo (REXTORP); additional attack phases are conducted with simulated torpedo firings.

- **Scenario 2: One Ship with Helicopter vs. One Submarine** (Figure 2-5). A ship, with a helicopter on board, approaches the range area and launches its helicopter to conduct a “stand-off” localization and attack. In some exercises, the ship conducts its own “close in” attack simulation (i.e., where the ship gets close enough to track the submarine using its own hull-mounted sonar). Each exercise period typically involves the firing of one EXTORP by the ship or helicopter or, in some cases, by both. Some ships carry two helicopters, but only one participates in the exercise at any one time. While the ship is searching for the submarine, the submarine may practice simulated attacks against the target and on average would launch EXTORPs/REXTORPs during 50 percent of the exercises.

- **Scenario 3: One Submarine vs. Another Submarine** (Figure 2-6). Two submarines on the range practice locating and attacking each other. If only one submarine is available for the exercise, it practices attacks against a target simulator or a range support boat, or it practices shallow water maneuvers without any attack simulation

- **Scenario 4: Two Ships and Two Aircraft vs. One Submarine** (Figure 2-7). This scenario involves the same action as Scenario 2, but with two ships and two aircraft – helicopters or marine patrol aircraft – searching for, locating, and attacking one submarine. Typically, one ship and one aircraft are actively prosecuting while the other ship and the other aircraft are repositioning. While the ships are searching for the submarine, the submarine may practice simulated attacks against the ships and on average would launch torpedoes during 50 percent of the exercises. Multiple sources may be active at one time. Scenario 4 is operationally the busiest exercise on the range.

Range Use Scenario 1

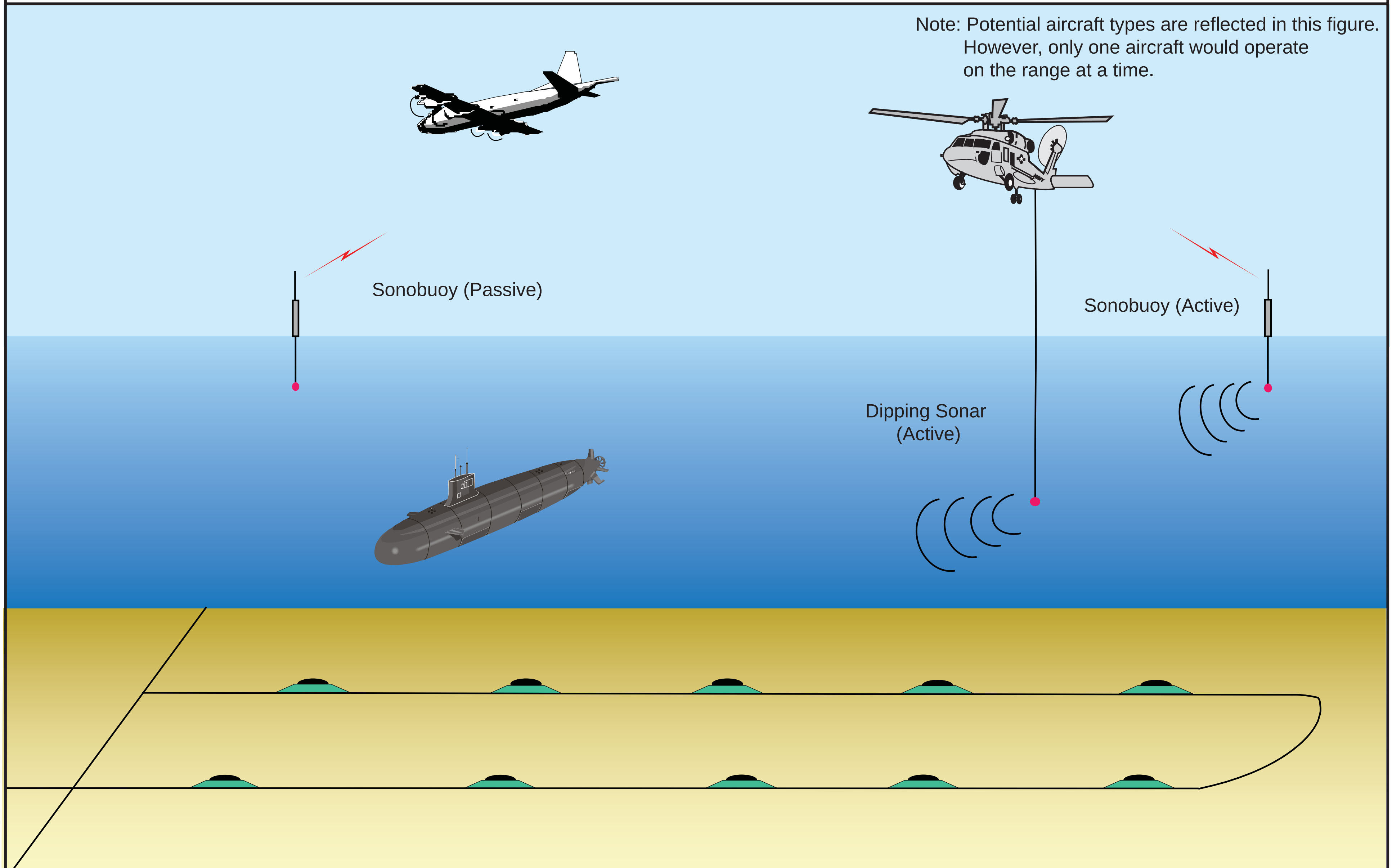


Figure 2-4

Range Use Scenario 2

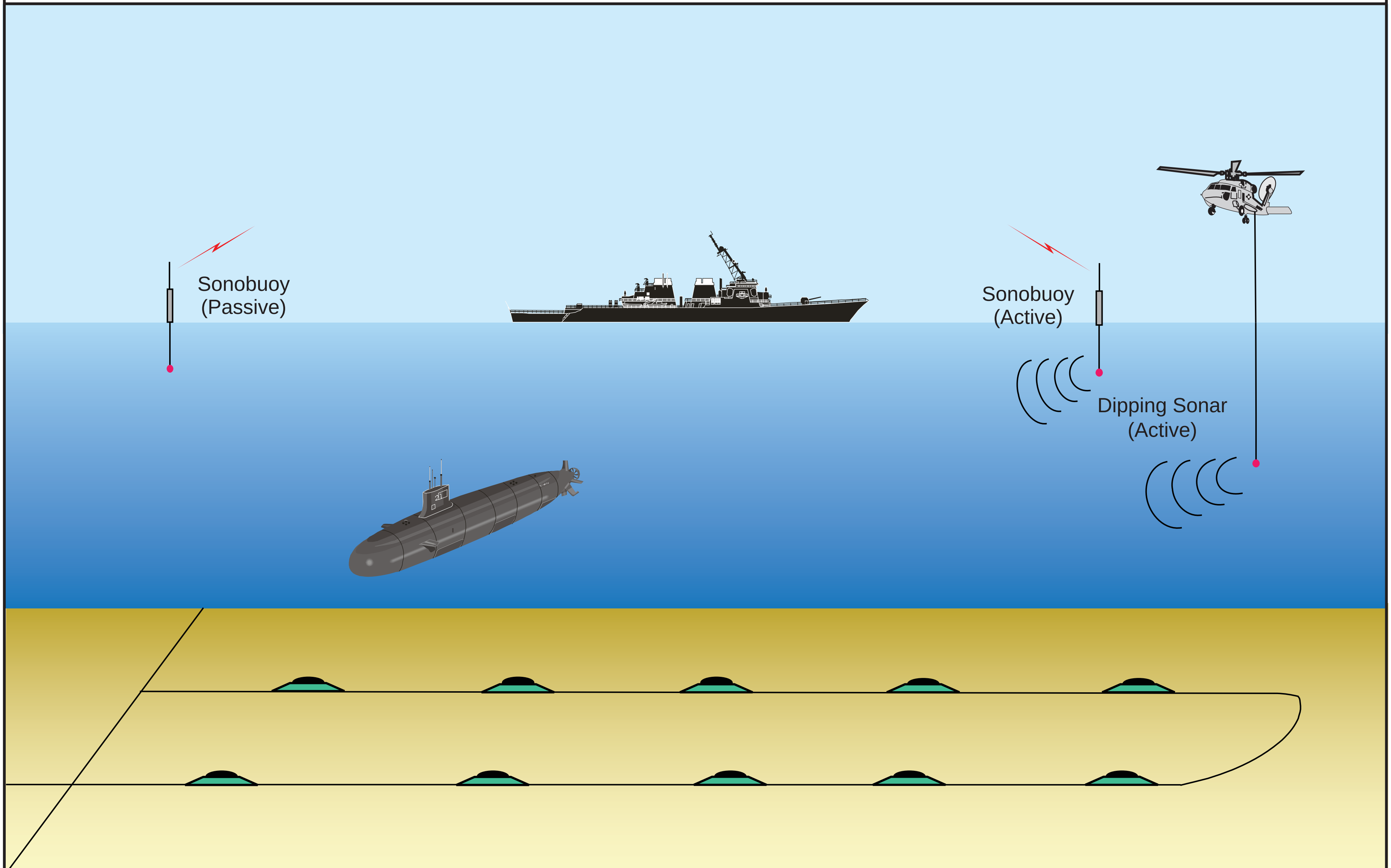


Figure 2-5

Range Use Scenario 3

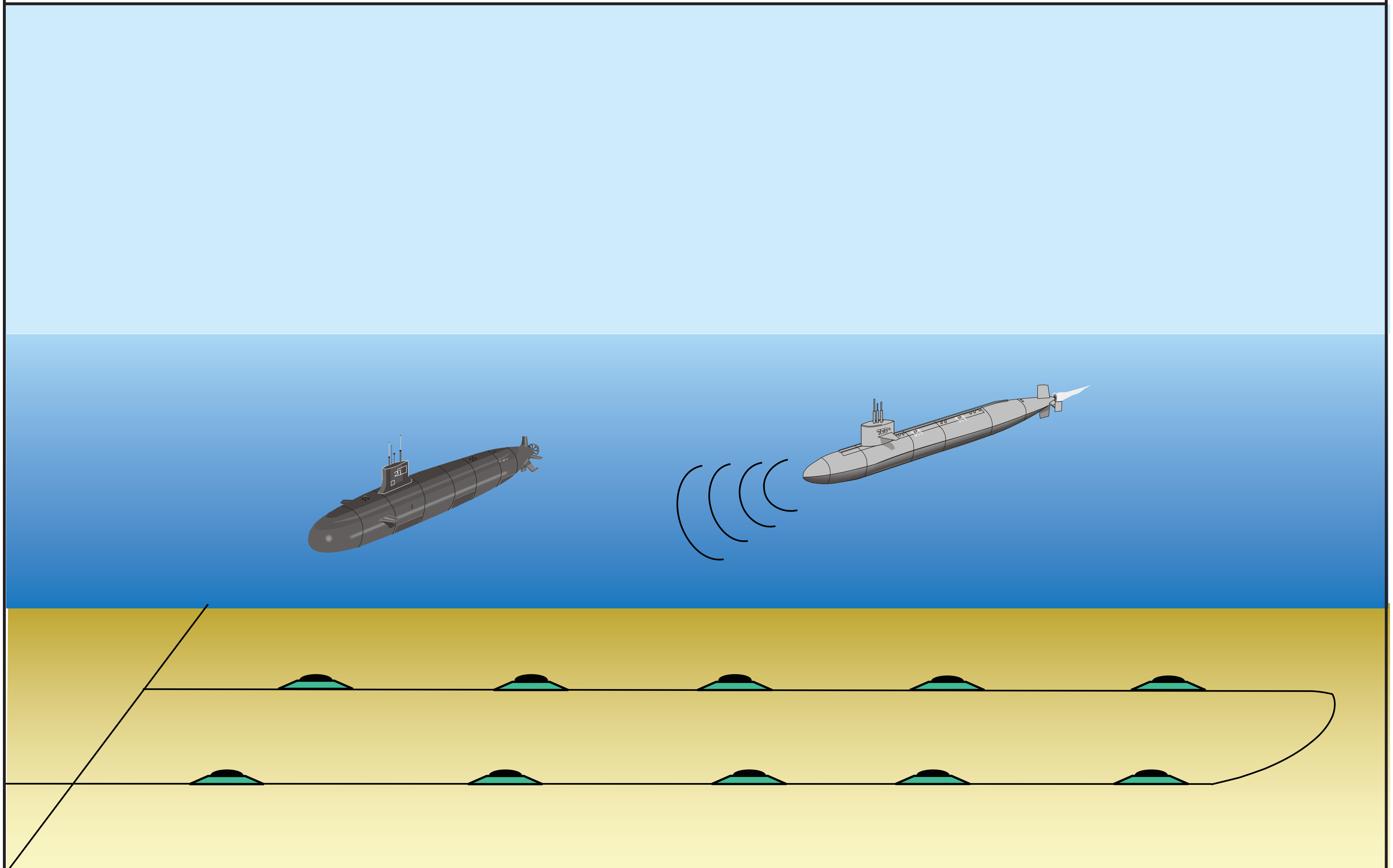


Figure 2-6

Range Use Scenario 4

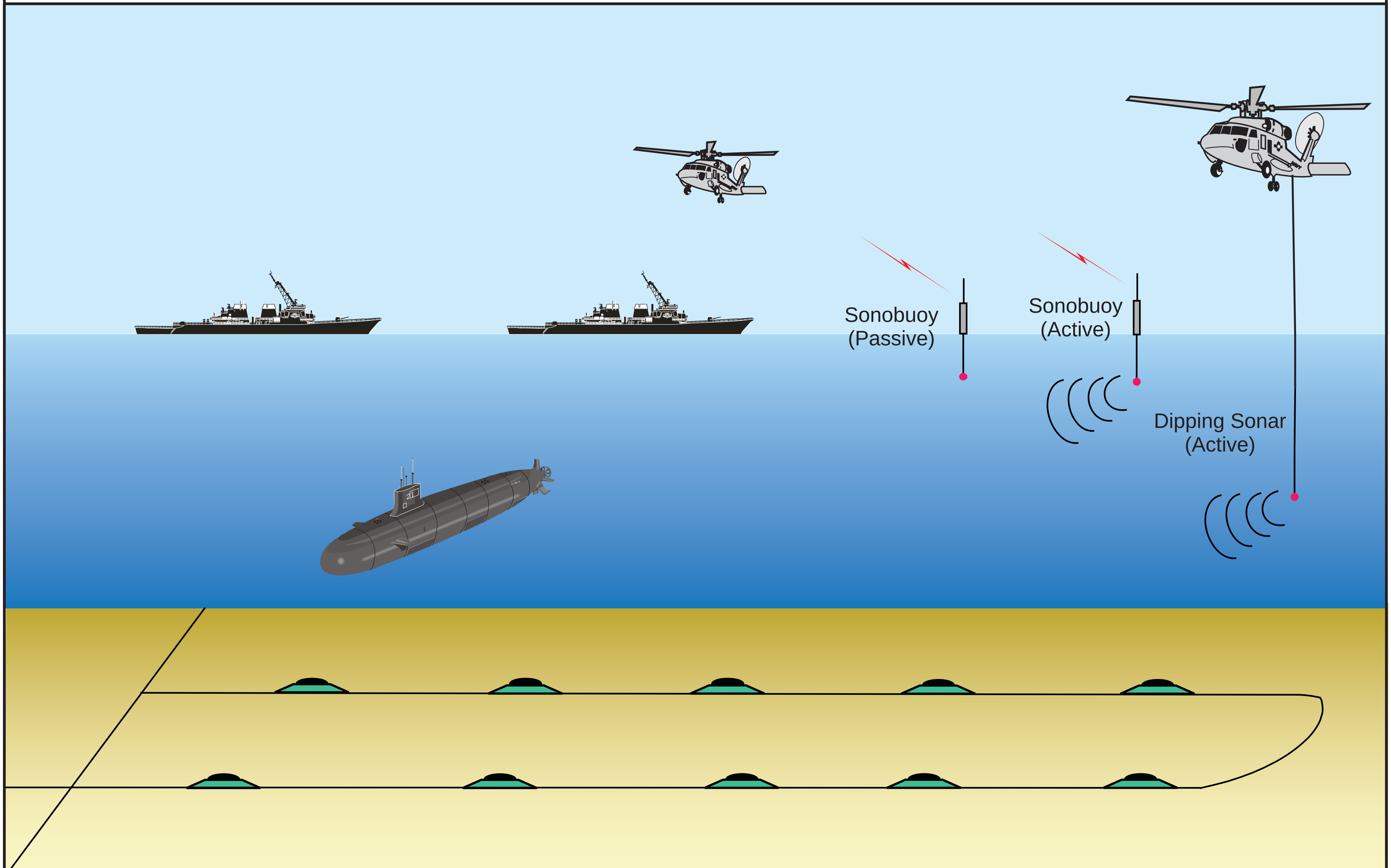


Figure 2-7

Table 2-2

USWTR Scenarios

Component	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Exercise Participants	One fixed- or rotary-wing aircraft vs. one submarine target	One ship and one helicopter vs. submarine target	One submarine vs. one submarine target	Two surface ships and two helicopters vs. submarine target
Non-explosive Exercise Weapons Used	Lightweight EXTORPs and lightweight recoverable exercise torpedoes (REXTORPs)	Lightweight and heavyweight EXTORPs (and once per year, a vertical launch antisubmarine rocket [VLA] may be fired from a ship on range) and REXTORPs	Heavyweight EXTORPs	Lightweight and heavyweight EXTORPs (and once per year, a VLA may be fired from a ship on range) and REXTORPs
Active Sound Sensors/ Sources Used	Active sonobuoys, dipping sonar, range pingers, torpedo sonar, underwater communication devices, submarine acoustic countermeasures, and anti-torpedo decoys (NIXIE)	Ships' sonar, active sonobuoys, range pingers, dipping sonar, torpedo sonar, and underwater communication devices, submarine acoustic countermeasures, and NIXIE	Submarine sonar, range pingers, torpedo sonar, and underwater communication devices	Ships' sonar, active sonobuoys, range pingers, dipping sonar, torpedo sonar, and underwater communication devices, submarine acoustic countermeasures, and NIXIE
Other Devices Used	Passive sonobuoys, target simulators, submarine acoustic countermeasures, and expendable bathythermographs (XBTs)	Passive sonobuoys, target simulators, submarine acoustic countermeasures, and XBTs	Submarine acoustic countermeasures, submarine target simulators, and XBTs	Passive sonobuoys, target simulators, submarine acoustic countermeasures, and XBTs
Approximate Duration of Exercise	2 hours (helicopter) 4 – 5 hours (fixed wing)	3 hours	6 hours	3 hours
Frequency of Exercise	355 exercises per year	62 exercises per year	15 exercises per year	38 exercises per year
Comments	Submarine targets can be an actual submarine or submarine target.	Submarine targets can be an actual submarine or submarine target.	One submarine simulates a quiet diesel-electric submarine. The other attempts to detect, locate, and simulate attack.	Submarine targets can be an actual submarine or submarine target.

Table 2-3

Training Platforms, Targets, Exercise Weapons, and Sonar Systems Used on a USWTR

Item	Description	Estimated Usage per Year
PLATFORMS		
Surface Ships	East coast multi-mission surface combatants including destroyers, cruisers, and frigates are primarily homeported at Norfolk, Virginia, and Mayport, Florida.	140
Submarines	Attack submarines are designed to seek and destroy enemy submarines and surface ships. Submarines primarily from east coast homeports of Norfolk, Virginia, Groton, Connecticut and Kings Bay, Georgia would use the range.	15
Helicopters	For ASW, helicopters operate at an altitude of 0 to 760 m (2,500 ft). The SH-60 Seahawk (SH-60B) is a twin-engine helicopter flown from cruisers, destroyers, and frigates. The SH-60F is essentially the same basic airframe with a different sensor suite and is flown from carriers. For ASW, the SH-60B uses magnetic anomaly detection, sonobuoys (monitored both onboard and on its host ship via link), radar, radar detection equipment (electronic support measures), and both aided (forward-looking infrared, low-light vision ‘night vision,’ or binoculars), and unaided visual search. The SH-60F’s primary ASW sensor is a dipping active and passive sonar that is employed from a hover. It can use sonobuoys. The SH-60F does not have magnetic anomaly detection gear, radar, or sophisticated electronic support measures. The homeport for both helicopters is Jacksonville Florida. The SH-60F is at NAS Jacksonville and the SH-60B is nearby at NS Mayport. The MH-60R is the replacement for both the SH-60B and the SH-60F and will also be based in NAS Jacksonville and NS Mayport. It will have a dipping sonar plus elaborate radar, electroptics, and electronic support measures.	320
Fixed-Wing Aircraft	Maritime patrol aircraft from Jacksonville, Florida, operate from near the ocean surface to 3,050 m (10,000 ft). They carry advanced submarine detection sensors such as active and passive aircraft launched sonobuoys and magnetic anomaly detection gear. Maritime patrol aircraft have the longest on-station time of any ASW aircraft. All Atlantic coast fixed wing ASW aircraft will be based in Jacksonville.	180
Range Support Craft	Range support craft are approximately 61-m-long (200-ft-long) range support boats. They are used for launching and recovering targets and for recovering EXTORPs and REXTORPs. On some days, the range boat participating in training exercises would retrieve multiple pieces of equipment. Range support craft will be based at NS Mayport.	220

Table 2-3

Training Platforms, Targets, Exercise Weapons, and Sonar Systems Used on a USWTR

Item	Description	Estimated Usage per Year
TARGETS		
Mk 30 ASW Target Simulator	The Mk 30, an electrically propelled target, is the current standard U.S. Navy submarine target simulator. The target is 54 cm (21 in) in diameter, 6.2 m (20 ft) long, and weighs 1,220 kg (2,700 lbs). It can be launched from a surface craft or dropped by a helicopter, and may be recovered by either surface craft or helicopter. The Mk 30 can tow a 92-m (300-ft) array consisting of a hydrophone, a projector (to simulate submarine signatures), and a magnetic source (to trigger magnetic anomaly detection gear). It either runs a preprogrammed trajectory or is controlled by signals transmitted from the range. The Mk 30 can run for about six hours (depending on the speed selected) and is fully recovered at the end of each run. It is reconditioned and reused.	180
Mk 39 Expendable Mobile Acoustic Torpedo Target	The Mk 39 expendable mobile acoustic torpedo target is an electrically propelled air- or ship-launched submarine simulator. It is 12.4 by 91.4 cm (4.9 by 36 in) and weighs 9.6 kg (21 lbs). The Mk 39 target acts as an echo repeater for active sonars and an acoustic target for passive detection. It can also deploy a 30.5-m (100-ft) wire to produce a recognizable magnetic anomaly detection signature. The Mk 39 contains lithium batteries. If launched from an aircraft, the Mk 39 separates from its parachute assembly. The parachute (1.2 m^2 [4 ft^2] in diameter) is jettisoned and sinks away from the unit. When the Mk 39 enters the water following the launch, it typically travels 9 m (30 ft) downward, then activates itself and begins its preprogrammed run for several hours. The target typically runs for 6 hours, but has the capability to run up to 11 hours. At the completion of the run, the Mk 39 scuttles and sinks to the ocean bottom.	160

Table 2-3

Training Platforms, Targets, Exercise Weapons, and Sonar Systems Used on a USWTR

Item	Description	Estimated Usage per Year
EXERCISE WEAPONS		
Mk 46 and Mk 54 Lightweight EXTORPs, and REXTORPs	Mk 46 and Mk 54 are high-speed lightweight torpedoes that are launched from helicopters, fixed-wing aircraft, and surface ships. These torpedos are approximately 13 inches in dIameter and up to 10 feet long. The Mk 46 and Mk 54 have an OTTO fuel II propulsion system and primarily use acoustic homing. An exercise torpedo that actually “runs” is referred to as an “EXTORP.” Only about 10 percent of the lightweight shots would be “runners.” The remaining shots are non-running “dummy” torpedo shapes called “REXTORPs.” REXTORPs do not have fuel sources. All torpedoes would be recovered. A parachute assembly for aircraft-launched torpedoes is jettisoned and sinks. The parachutes range from 0.37 to 0.84 m^2 (4 to 9 ft^2).	330 (300 “non-runners,” 30 “runners”)
Mk 48 Advanced Capability (ADCAP) Heavyweight EXTORPs	Mk 48 ADCAP is the current standard U.S. Navy heavyweight torpedo for use by submarines and has an OTTO fuel II propulsion system. Over its service life the MK48 has been extensively modified to remain current with the threat. The Mk 48 ADCAP is an extensively modified version of the Mk 48 torpedo, capable of greater speed and endurance. The torpedo uses passive and active acoustic homing modes, and also can operate via wire guidance from the submarine. The guidance wire is generally 28 km (15 NM) long and 0.11 cm (0.043 in) in diameter. The maximum tensile breaking strength of the wire is 19 kg (42 lb). All Mk 48 ADCAP exercise shots would be EXTORPs. All torpedoes would be recovered.	Approx. 50
Vertical Launch Antisubmarine Rocket	The vertical launch antisubmarine rocket provides naval surface ships with a rapid-response all-weather ASW and standoff weapon capability to offset the advantages that enemy submarines enjoy by virtue of being submerged and acoustically silent. A Mk 46 or Mk 54 EXTORP is mounted on one of these rockets, which is launched from a surface ship. During flight, the torpedo separates from the rocket airframe and parachutes into the sea. The torpedo would be recovered.	Approx. 10

Table 2-3

Training Platforms, Targets, Exercise Weapons, and Sonar Systems Used on a USWTR

Item	Description	Estimated Usage per Year
SENSORS		
Sonobuoys	A sonobuoy is an expendable device used for the detection of underwater radiated or reflected sound energy from a target submarine and for conducting vertical water column temperature measurements. There are three basic types of sonobuoys: passive, active, and expendable bathythermographs (XBTs; see below). Sonobuoys are launched from aircraft and ships. Following deployment, sonobuoys' sensors descend to specified depths. A float containing a wire antenna is inflated and goes to the surface from the depth at which the buoy is deployed (generally about 27 to 122 m [90 to 400 ft]). Data measurements are transmitted to the surface unit via an electrical cable and the information is then radioed back to an aircraft or ship. Sonobuoys are cylindrical devices about 12.5 cm (4.9 in) in diameter and 91 cm (36 in) in length. They weigh between 6 and 18 kg (14 and 39 lbs). At water impact, a seawater battery activates and deployment initiates. The parachute assembly (aircraft launched only) is jettisoned and sinks away from the unit, while a float containing an antenna is inflated. The parachute canopies are generally 20 to 30 cm (8 to 12 in) in diameter. The subsurface assembly descends to a selected depth. There, the sonobuoy case falls away and sea anchors deploy to stabilize the hydrophone (underwater microphone). The operating life of the seawater battery is programmable up to eight hours, after which the sonobuoy scuttles itself and sinks to the ocean bottom.	Approx. 3,000
Expendable Bathythermograph (XBT)	XBTs are launched from aircraft, ships, and submarines. An XBT system consists of an expendable probe, a data processing/recording system, and a launcher. An XBT is a device for obtaining a record of temperature as a function of depth. The XBT probe has a single, fine copper wire that spools out at the launch end. A return signal is received via a sea water return consisting of a wire whose end is in contact with the sea water. Eventually, the wire runs out and breaks and the XBT sinks to the ocean floor. Airborne versions are also used; these use radio frequencies to transmit the data to the aircraft during deployment. Data are recorded as the probe falls. ASW operators use temperature profiles data obtained by the XBT to identify the impact of temperature on sonar propagation and acoustic range prediction (Lockheed Martin, 2007).	Approx. 470

Table 2-3

Training Platforms, Targets, Exercise Weapons, and Sonar Systems Used on a USWTR

Item	Description	Estimated Usage per Year
SENSORS (cont'd)		
Ship and Submarine Sonars	Surface ships and submarines are equipped with both active and passive sonar to search for, detect, localize, classify, and track submarines and surface ships. Passive systems do not emit any energy and therefore are not a subject of this OEIS/EIS. The primary active sonar systems for surface ships are the SQS-53 and SQS-56 class sonar systems. The primary submarine active sonar is the BQQ–10. Submarines are also equipped with several types of auxiliary sonar systems for ice and mine avoidance, for top and bottom sounders to determine the submarine's distance from the surface and the bottom in the water column, and for acoustic communications.	Per ship and submarine usage as listed above.
Dipping Sonars	Dipping sonars are active or passive sonar systems that are lowered on cable by helicopters to detect or maintain contact with underwater targets. Although not all of the current inventory of rotary wing ASW aircraft are equipped with dipping sonar (SH-60B is not so equipped, SH-60F is equipped), the MH-60R, which is replacing both the SH-60B and SH-60F, will have dipping sonar. The usage number to the right reflects the assumption that eventual usage of the range will be exclusively by the MH-60R.	Approx. 320
COUNTERMEASURES		
Acoustic Device Countermeasures	Submarines launch acoustic device countermeasures to foil opponents' sensors and weapons. They are sound-producing decoys, typically cylinder-shaped. They are 8 to 15 cm (3 to 6 in) in diameter, 102 to 280 cm (40 to 110 in) long, and weigh between 3 and 57 kg (7 and 125 lbs).	Approx. 40
Anti-torpedo Decoy (NIXIE)	Surface ships sometimes trail an anti-torpedo decoy called a NIXIE when faced with a possible torpedo attack. The NIXIE is a small cylindrical sound-producing decoy at the end of an approximately 2.5-cm (1-in)-thick smooth cable, which is towed approximately 100 m (330 ft) astern of the ship. The NIXIE generates sounds to create a false target for the torpedo. Both the device and cable are smooth and slick to prevent any unwanted sounds from entering the water. The device is not typically used for long periods as it restricts ships movements.	Est. fewer than 20 events

The four scenarios would be run an estimated 470 times each year (Table 2-4). Often, multiple scenarios will be conducted sequentially within one day, so that this does not equate to training every day during the year. The Navy plans to train throughout the year to meet the requirements and schedules associated with the FRTP and the potential for immediate deployment of forces (see Subchapter 1.2).

Table 2-4

Annual Approximate Tally of ASW Training Exercises

Scenario	Approximate # Stand-Alone Exercises	Approximate # Exercises During JTFEX and COMPTUEX	Approximate Annual Total Exercises
1	319	36	355
2	62	0	62
3	15	0	15
4	8	30	38
Total Annual Exercises on Range			470
Note: JTFEX and COMPTUEX are multi-unit exercises. When their participants work on the USWTR, their numbers are represented above.			

In their large east coast OPAREAs, the Navy also conducts broader-scale exercises called joint task force exercises (JTFEX) and composite training unit exercises (COMPTUEX). In the case of these larger exercises, some units may break off and conduct operations on the USWTR, following one of the described exercise scenarios. The totals in Table 2-4 include these additional training exercises. On any given day, the training scenario used may vary in some measure from one of the four scenarios described here, or more than one scenario may occur simultaneously on the range, but the total of all these scenario runs would represent the typical annual spectrum of training activities on the range. Any such variations would be within the range of analyzed impacts.

All vessels using the USWTR range will assume a slow, safe speed that is dependent upon the situation. The vessel speed relies upon the judgment and experience of the vessel's captain to allow the ship to maneuver around any navigational hazards (including marine mammals). Navy vessels will additionally abide by the USCG Navigation Rules (USCG, 2008b) while traveling and using the USWTR range. Vessels may operate in a manner outside the Navigation Rules when the training exercise requires realistic combat maneuvers.

2.2.2.2 Active Acoustic Devices Used on the USWTR

Tactical ASW sonars are designed to search for, detect, localize, classify, and track submarines. There are two types of sonars, passive and active.

- Passive sonars only listen to incoming sounds and, since they do not emit sound energy in the water, lack the potential to acoustically affect the environment.

- Active sonars emit sounds that bounce off an underwater object to determine information about the object. Active sonars are the most effective detection systems against modern, ultra-quiet submarines in shallow water. Mid-frequency active sonar can also be referred to as: mid-frequency tactical sonar, mid-frequency range sonar, tactical mid-range sonar, or tactical mid-frequency active sonar.

Modern sonar technology has developed a multitude of sonar sensor and processing systems. In concept, the simplest active sonars emit omnidirectional pulses (pings) and time the arrival of the reflected echoes from the target object to determine range. More sophisticated active sonar emits an omnidirectional ping and then rapidly scans a steered receiving beam to provide both directional and range information. More advanced sonars use multiple preformed beams, listening to echoes from several directions simultaneously and providing efficient detection of both direction and range

The military sonars to be deployed in the USWTR are designed to detect submarines in tactical operational scenarios. This task requires the use of passive sonars across a broad spectrum and active sonars in the mid-frequency range (1 to 10 kHz) predominantly.

The types of tactical sound sources that would be used in training exercises on the range include:

- **Surface Ship Sonars.** Although most (greater than 60 percent) surface ships do not have any tactical active sonar (i.e., aircraft carriers, amphibious ships, and support ships), those surface combatants with ASW as a primary mission (FFGs, DDGs, CGs) are so equipped and will operate mid-frequency sonar on the USWTR.

- **Submarine Sonars.** Tactical military submarine sonars are used to detect and target enemy submarines and surface ships. Use of these active sonars is minimized to prevent detection by enemy submarines and surface ships. Submarines are also equipped with several types of auxiliary sonar systems for ice and mine avoidance, to determine the submarine's depth (distance to the surface or underside of ice) and the submarine's height from the bottom. Submarines are also equipped with underwater communications devices.

- **Aircraft Sonar Systems.** Aircraft sonar systems that would operate on the USWTR consist of sonobuoys and dipping sonars.

- **Torpedoes.** Torpedoes are the primary ASW weapon used by surface ships, aircraft, and submarines. The guidance systems of these weapons can be autonomous or, if launched by a submarine, electronically controlled from the launching platform through an attached wire. The autonomous guidance systems use onboard sonars. They operate either passively, exploiting the emitted sound energy by the target, or actively, homing on the received echoes. All torpedoes to be used at the USWTR would be non-explosive and recovered after use.

- **Acoustic Device Countermeasures.** Acoustic device countermeasures are submarine simulators and act as decoys to avert localization and/or torpedo attacks.

- **Training Targets.** ASW training targets are used to simulate target submarines. They are equipped with one or a combination of the following devices: (1) acoustic projectors emanating sounds to simulate submarine acoustic signatures; (2) echo repeaters to simulate the characteristics of the echo of a particular sonar signal reflected from a specific type of submarine; (3) magnetic sources to trigger magnetic detectors. Both expendable and recoverable training targets would be used on the USWTR.

- **Range Sources.** Range pingers are active sound-producing devices that allow each of the in-water platforms on the range (e.g., ships, submarines, target simulators, and EXTORPs) to be tracked by the range transducer nodes. In addition to passively tracking the pinger signal from each range participant, the range transducer nodes are also capable of transmitting signals for a limited set of functions. These functions include submarine warning signals, signalized commands to submarine target simulators, and occasional voice or data communications (received by participating ships and submarines on range).

2.2.3 Range Logistics Support

In general, the USWTR would take advantage of existing logistics support for range operations. However, some independent logistical support arrangements must be made for the delivery and recovery of targets and torpedoes.

2.2.3.1 Target Support

Recoverable targets (i.e., Mk 30s) may be used on the USWTR approximately 175 times a year. These targets are distinct from the expendable Mk 39 acoustic torpedo and are fully recovered. A range support boat provides the range with the targets for the training exercises. One range craft would be on site whenever a Mk 30 is in use.

Range users would deploy expendable targets as needed. Range support craft are not needed for expendable targets.

2.2.3.2 Exercise Torpedo Support

Either REXTORPs or EXTORPs may be launched in an attack on the range by ships and aircraft (both marine patrol aircraft and helicopters). An EXTPORP is an actual torpedo without a high-explosive warhead and configured for exercise use. A REXTORP is a torpedo-shaped dummy without propulsion, seeker assembly, or warhead. At the end of the torpedo run, specially designed and equipped range torpedo recovery boats or specially equipped recovery helicopters typically recover EXTORPs. However, if a torpedo recovery boat is not available, all surface combatants are trained and equipped to recover torpedoes.

When an EXTORP is recovered, the fuel tank is full of liquid composed of seawater and fuel. The EXTORP is returned to a range support facility (which could be portable) where this liquid is removed and stored for later processing under existing procedures. The unit is then flushed with a non-corrosive preservative and is transported to an intermediate maintenance facility for rebuild. Typically, individual torpedoes are reused approximately 20 times.

Helicopters working from ships would not require shore support, and maritime patrol aircraft would be supported by their home base. If USWTR is constructed on a site other than Site A, helicopters not operating from ships would require a minimal staging area to onload/offload and, potentially, to store torpedoes, depending on how often the torpedoes are used on the range. Squadron personnel would have to be brought into the staging area on a temporary basis to assemble and onload/offload the torpedoes.

The staging area would be located at an existing airfield located within 148 km (80 NM) of the training range. The 148-km (80-NM) distance is based on the fuel limitations of the recovery helicopters. Standard operating procedures also dictate that helicopters should avoid overflights of populated civilian land areas when carrying suspended loads.

2.3 Site Selection Process

This subchapter presents the process that was used to identify potential USWTR sites, to develop a set of alternatives that would meet the overall purpose and need of the proposed action, and ultimately to select the preferred alternative.

This site selection process is detailed in the following subchapters:

- 2.3.1 contains a short overview.
- 2.3.2 provides details of the initial site screening process.
- 2.3.3 contains a discussion of the range layouts and locations of the candidate sites.

- 2.3.4 discusses site evaluation criteria, concluding with an overview of the October 2005 draft OEIS/EIS and the September 2008 draft OEIS/EIS, and a discussion of critical and non-critical operational evaluation criteria.
- 2.3.5 presents the results of evaluating the candidate sites against the critical and non-critical criteria, by site.
- 2.3.6 contains a summary table with the conclusions for each site, by evaluation factor.

2.3.1 Site Selection Process Overview

Operational requirements for the USWTR site are set forth in what is called an operational requirements document (ORD) (Subchapter 2.3.2.1). The ORD contains both the operational and physical requirements for the USWTR and is the basis for the site selection process.

Given these requirements, the Navy conducted an initial scan of the eastern coast of the United States and the Gulf of Mexico. The scan resulted in selection of four broad regions that met the bathymetric subcriteria. One of these regions, the Gulf of Mexico, contained sites with appropriate bathymetry, yet the sites proved logistically infeasible due to extreme distance from existing Navy homeports (see Subchapter 2.3.2.2).

Five candidate sites within the JAX, Charleston, Cherry Point, and VACAPES OPAREAs and the Gulf of Maine were identified in the next step (Subchapter 2.3.2). Those sites were next evaluated using a set of critical criteria (Subchapter 2.3.4). Critical criteria are those criteria that must be met for a candidate site to be considered feasible. They are criteria that cannot be worked around regardless of cost. At this point, the Gulf of Maine OPAREA was eliminated from further consideration due to its rating of unsatisfactory on climatological suitability, a critical factor.

The remaining four candidate sites were then evaluated against a set of non-critical criteria, also discussed in more detail in Subchapter 2.3.4. These criteria are important considerations, but an inability to meet one of them would not preclude a candidate site from further consideration. A site may still be feasible if it does not meet one or more of these non-critical criteria, but it would generally require greater installation or operating costs in order to fulfill the operational requirements for the USWTR. Candidate sites are not eliminated from consideration by their rating on these non-critical criteria; however, Fleet, in its review to determine the operationally preferred site, does consider the relative ranking of the sites in terms of non-critical criteria.

2.3.2 Initial Site Screening Process

2.3.2.1 Operational Requirements

In selecting a site for the proposed USWTR, the initial step was to hold extensive consultations with the Fleet commands to determine what subcriteria were required to establish an effective USWTR. These criteria were detailed in the ORD for the range. Figure 2-8 depicts the process by which the operationally preferred alternative was selected.

The preliminary requirements were:

- A geographical area of about 1,713 km^2 (500 NM^2).
- Water depths ranging from 37 to 274 m (120 to 900 ft).

Water depths beyond these limits were acceptable for candidate sites, but the bulk of the potential sites' areas needed to be within these bounds (see Subchapter 2.3.4.4).

These two requirements were the basis of the initial scan of the eastern coast of the U.S. and the Gulf of Mexico. As cited previously, this scan was conducted to identify potential areas of bathymetry suitable for a USWTR. The scan, using navigational charts from NOAA that display water depths, resulted in selection of four broad regions along the U.S. coastline for consideration. These regions were found to contain bathymetry matching the operational criteria:

- The Gulf of Mexico region extending from southwest of the Mississippi River delta in Louisiana on the western side to southwest of Cape San Blas in Florida and centered approximately 46 to 93 km (25 to 50 NM) south of the coastline.

- The southeastern coastline region from Cape Lookout, North Carolina, on the northern end and Cape Canaveral, Florida, on the southern end, centered approximately 46 to 111 km (25 to 60 NM) from the coastline.

- The area centered approximately 93 km (50 NM) east of the Delaware/Maryland/Virginia (DELMARVA) peninsula (also referred to as the Virginia Capes, or VACAPES, area) and extending from Cape May, New Jersey, on the northern end to the entrance of the Chesapeake Bay on the southern end.

- The Gulf of Maine region located approximately 37 to 111 km (20 to 60 NM) east of Cape Ann, Massachusetts, and approximately 65 to 102 km (35 to 55 NM) north/northeast of the tip of Cape Cod, Massachusetts.

As noted in Subchapter 2.1, the possibility of siting the USWTR adjacent to the Navy's existing instrumented ranges at AUTEC was also considered, but eliminated.

Site Selection Process Flow Chart

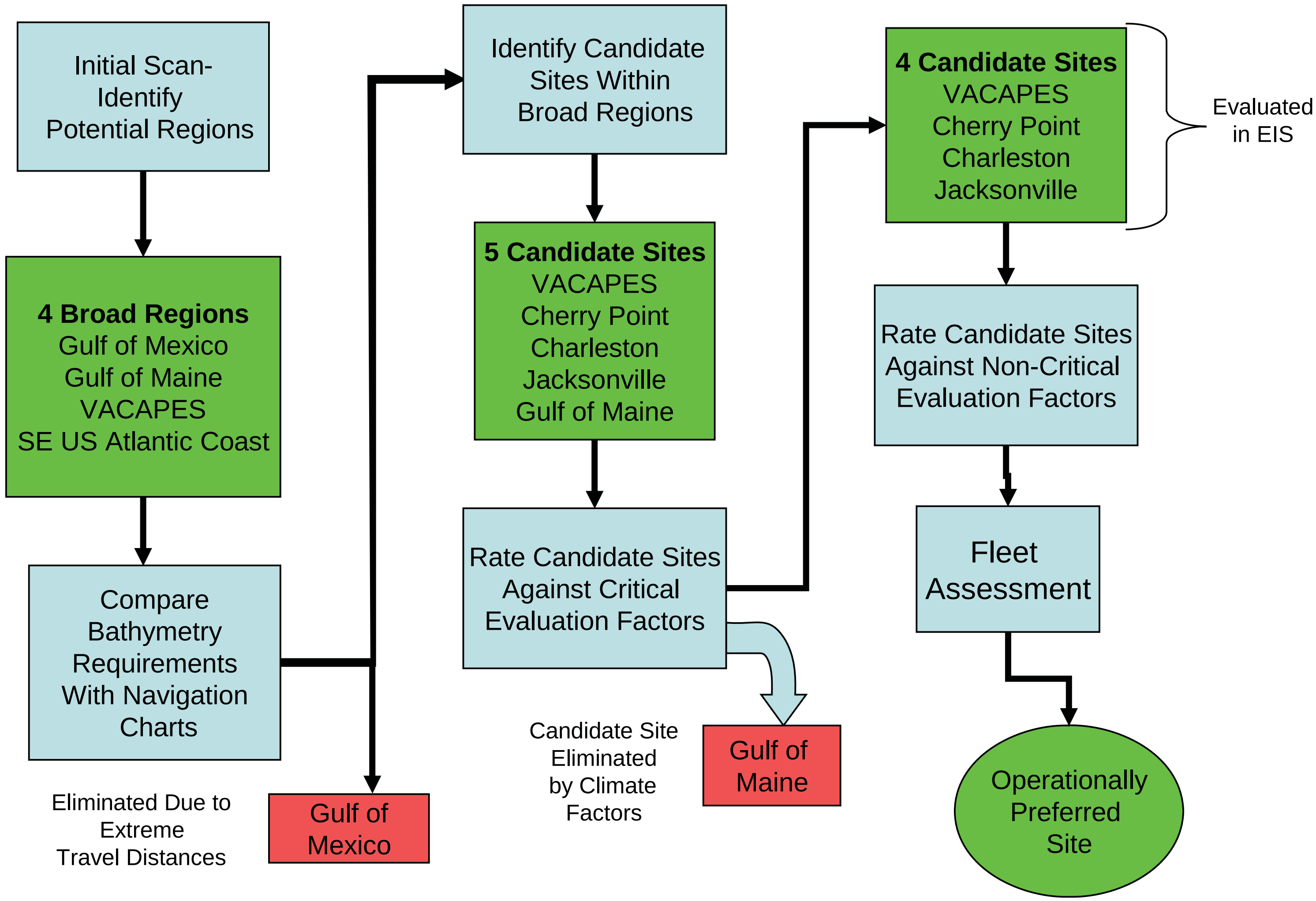


Figure 2-8

2.3.2.2 Proximity to Fleet Concentration and Training Areas

Proximity to existing Fleet homeports was an important consideration at two different levels of review. As an initial screening criterion, it was important that the training area not be located an extreme distance from homeports due to lengthy transit times to and from planned exercises. These transit times would pose serious operational and logistic concerns related to both frequency of training events and costs of transport to and from the range. Since it would take the the participants longer to reach the range, training would not be able to happen as frequently as desired. The additional fuel and equipment maintenance costs associated with lengthy travel would prove fiscally prohibitive. Transit distances are especially critical for submarines and suface ships due to their slower speeds and greater operating costs compared to aircraft, but in fact, the benefits of proximity to homeports also apply to helicopters and maritime patrol aircraft. Proximity to homeports is later used as a comparative non-critical criterion (see Table 2-6 and Section 2.3.4.5) to discern cost effectiveness of the alternative sites on a smaller scale.

Helicopters, the prime users of the range, have the greatest logistical issues relative to the location of a training range. For the helicopters, having the range within a short flight distance affords an opportunity to train without the need for a host surface ship to get underway or the squadron to send personnel and equipment away from the home base as a temporary support detachment. These are significant considerations for this user.

The majority of operational assets that would be utilizing the USWTR are located along the east coast of the U.S., where the Fleet's primary homeports for surface ships are Norfolk, Virginia, and Mayport, Florida. All ASW helicopters are based in Jacksonville, Florida. Finally, in approximately 2011, the P-8A multi-mission maritime aircraft, the follow-on to the P-3C, will enter service. A Record of Decision was issued on Decemebr 23, 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron (FRS) into the U.S. Navy Fleet. In 2012, the P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion at existing maritime patrol homebases. This action will result in the homebasing of five fleet squadrons (30 aircraft) and one Fleet Replacement Squadrons (FRS) (12 aircraft) to Naval Air Station (NAS) Jacksonville, Florida.

The area in the Gulf of Mexico that would meet the areal size and bathymetric requirements for a USWTR range would be about 2,630 km (1,420 NM) from Norfolk and about 1,800 km (970 NM) from Mayport (by comparison, the Gulf of Maine area, second to the Gulf of Mexico area in terms of distance to a primary homeport, is about 1,060 km (570 NM) from Norfolk). If a USWTR were installed in the Gulf of Mexico, lengthy transit times for surface ships and submarines would be necessary prior to and after the training exercises. The ship transit times would be approximately 3.5 days from Norfolk, Virginia and 2.5 days from Mayport, Florida. Additionally, climatological challenges, such as hurricanes, prevent the use of the proposed site for a significant portion of the year and a high volume of offshore activity, such as oil drilling, commercial shipping and shrimping, render the site undesirable. Taken by themselves, these issues would normally be addressed serially though the site selection process outlined later in this chapter. In this one instance, however, the combination of marginal or unacceptable conditions makes it apparent that the Gulf of Mexico would fail for several reasons. Thus, the Gulf of Mexico was eliminated as being unreasonable per se.

2.3.3 Candidate Site Definition

To assess the quantitative and qualitative site evaluation criteria discussed in Subchapter 2.3.2, more clearly defined site locations were required for the three remaining areas (the southeast coastline, VACAPES OPAREA, and Gulf of Maine). Candidate sites were identified in these regions and evaluated against the criteria outlined below. The range layouts and locations for candidate sites (Figure 2-9) are as follows:

- **Southeast Coastline** – For the southeast coastline, much latitude existed in positioning a USWTR between Cape Canaveral, Florida, and Cape Lookout, North Carolina. Three separate candidate sites were identified, each offshore of existing military bases.

  - **JAX OPAREA** – The candidate site for the JAX OPAREA would be located east of Jacksonville, Florida. The cable would be landed at the NS Mayport.

    The candidate site was defined as a parallelogram measuring 49 by 36 km (26.3 by 19.3 NM). The water depths vary from approximately 37 to 366 m (120 to 1,200 ft) and the proposed range site edge is approximately 93 km (50 NM) from shore

  - **Charleston OPAREA** – The candidate site for the Charleston OPAREA would be located east of Charleston, South Carolina, and offshore of the former Charleston Naval Base. Fort Moultrie in Charleston, South Carolina, provides a possible shore landing site for the cable.

    The candidate site was defined as a quadrangle measuring 46 by 36 km (24.7 by 19.7 NM). The water depths vary from approximately 37 to 305 m (120 to 1,000 ft) and the proposed range site edge is approximately 74 km (40 NM) from shore.

  - **Cherry Point OPAREA** – The candidate site for the Cherry Point OPAREA would be located offshore of southeastern North Carolina, south of Cape Lookout. The Marine Corp Base Camp Lejeune in Jacksonville, North Carolina, provides a possible shore landing site for the cable.

    The candidate site was defined as a rectangle measuring 46 by 37 km (25 by 20 NM). The water depths vary from approximately 40 to 402 m (131

USWTR Alternative Site Locations

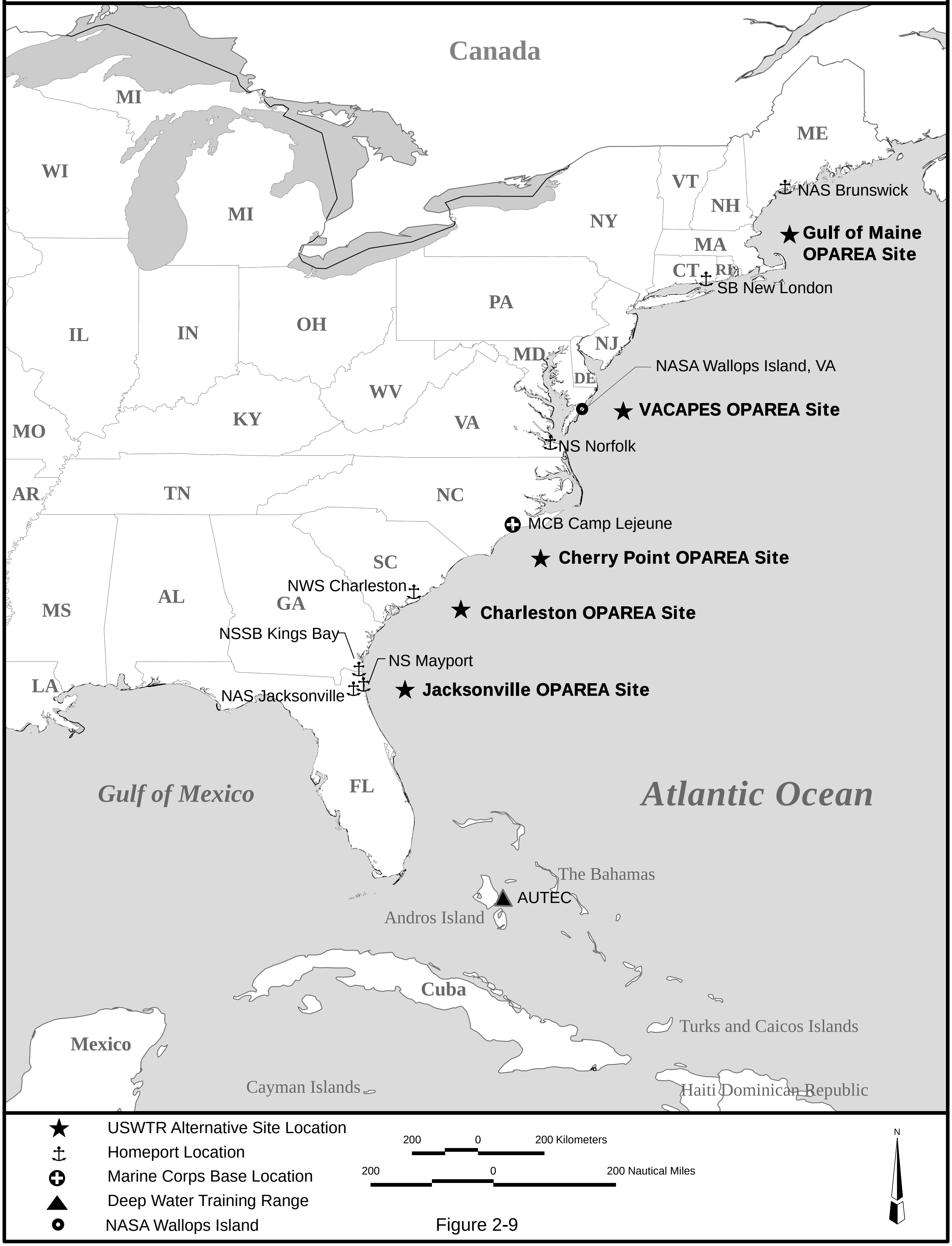


Figure 2-9

to 1,319 ft), and the proposed range site edge is approximately 86 km (47 NM) from shore.

- **VACAPES OPAREA –** The VACAPES OPAREA area offers a large overall area in which to locate the range. The closest approaches to shore occur in the southern half of the region from the mouth of the Delaware Bay south to the mouth of the Chesapeake Bay. The National Aeronautics and Space Administration (NASA) Wallops Flight Facility (WFF), located in Virginia, offers a possible shore landing site for the cable in between these two bay entrances.

  The candidate range site for VACAPES would be located offshore of northeastern Virginia. The candidate site was defined as a rectangle measuring 46 by 37 km (25 by 20 NM). The water depths vary from approximately 55 to 366 m (120 to 3,000 ft). The candidate range site edge is approximately 81 km (44 NM) from shore.

- **Gulf of Maine** – The Gulf of Maine region offers only a limited area of opportunity for siting the range while meeting the depth requirements. A possible cable shore landing site would be at the Portsmouth Naval Shipyard (NSY).

  The candidate range site for USWTR in the Gulf of Maine would be located east of Cape Ann, Massachusetts. This site was chosen to minimize the distance to shore. The site is defined as a parallelogram measuring 46 by 37 km (25 by 20 NM), with water depths that vary from approximately 37 to 274 m (120 to 900 ft). The candidate range site edge is approximately 46 km (25 NM) from shore.

2.3.4 Site Evaluation Criteria

2.3.4.1 October 2005 Draft OEIS/EIS

This section briefly summarizes the site evaluation for the October 2005 draft OEIS/EIS. The five specific candidate sites, JAX OPAREA, Charleston OPAREA, Cherry Point OPAREA, VACAPES OPAREA, and Gulf of Maine, were assessed against the criteria summarized in Table 2-5.

Evaluation of the candidate sites, presented in the October 2005 draft OEIS/EIS, indicated that the proposed construction and operation of a USWTR was reasonable in the following locations: JAX OPAREA, Cherry Point OPAREA, and VACAPES OPAREA. The analyses presented in the draft OEIS/EIS indicated that the preferred alternative for the USWTR at that time was in the Cherry Point OPAREA.

Table 2-5

Site Evaluation Criteria, October 2005 Draft OEIS/EIS

Quantitative Parameter	Satisfactory	Unsatisfactory
Air Station Proximity	Airfield located within 185 km (90 NM). No overflight of civilian land areas.	Airfields unavailable within 185 km (90 NM). Overflight of civilian land areas necessary.
Climatological Availability (wind speed, wave height, visibility)	Climatological limits less than 15 percent for 11 or more months.	Climatological limits exceed 15 percent for more than 1 month.
Shore Landing Site and Infrastructure	Existing federal shore facility with infrastructure requiring augmentation to handle range requirements.	No federal shore facility and no available infrastructure.

2.3.4.2 September 2008 Draft OEIS/EIS and June 2009 Final OEIS/EIS

New operational concerns, revised capabilities, and relocation of Fleet assets have resulted in the need for the Navy to readdress the suitability of the potential USWTR sites. To that end, site selection criteria were updated for the current OEIS/EIS to reflect the requirements associated with these developments, summarized as follows:

- The Navy refined the physiography criterion by incorporating a requirement for a balanced distribution of water depths around 137 m (450 ft) for the total range area. A candidate site with too much of its area at either the shallower or deeper water depths, with steep areas of transition from the shallow to deep depths, would not meet this need.

- A Record of Decision was issued on Decemebr 23, 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron (FRS) into the U.S. Navy Fleet. In 2012, the P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion at existing maritime patrol homebases. This action will result in the homebasing of five fleet squadrons (30 aircraft) and one Fleet Replacement Squadrons (FRS) (12 aircraft) to Naval Air Station (NAS) Jacksonville, Florida.

- Helicopter range for recovery has been updated based on standard operating procedures for existing deep water training ranges. The maximum range was reduced from 185 km (100 NM) to 167 km (90 NM). Direct transfer of recovered targets and torpedoes by helicopter to the airfield is preferred. If that is not possible, an in-water drop point could be created for transfer of targets and torpedoes; a helicopter would drop the target or torpedo near shore and a range support vessel would pick it up and transport it to land.

- Requirements for the cable landing area have been added, including proximity to shore, not crossing artificial reefs, and avoiding areas that may be affected by dredging.

- Shipping traffic data have been reexamined. A revised historical temporal shipping (HITS) database has been developed that includes more current shipping data of significantly higher resolution than previous data. However, due to discrepancies that were found in the HITS data, a qualitative assessment based on an analysis of shipping densities from a report issued by the Naval Oceanographic Office (NAVOCEANO) (NAVOCEANO, 2007) was utilized instead. While the shipping analysis provided by NAVOCEANO is of a lower resolution than the HITS data, the depiction of inbound/outbound traffic from major seaports near the candidate USWTR sites was deemed to be more representative of actual shipping activity. This analysis was augmented by a University of Delaware study (Wang et al., 2007) that used the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) and Automated Mutual-Assistance Vessel Rescue System (AMVER) data sets as proxies to measure global ship traffic intensity. These three spatial proxy datasets are available at http://coast.cms.udel.edu/GlobalShipEmissions/.

- Control of the airspace over the range is required to 7,766 m (24,000 ft). This does not preclude the existence of commercial air routes over the range.

The need for the USWTR to be close to joint training facilities (e.g., with U.S. Air Force [USAF], Marines, and/or Army) was assessed early in the site selection process. It was determined that such proximity is not necessary to meet the range of training activities that would be conducted on the USWTR. That criterion was subsequently dropped. Also, since an air tracking capability could be provided as part of the USWTR program, the availability of an existing air tracking system would not need to be a consideration.

2.3.4.3 Critical and Non-Critical Operational Criteria

This subchapter contains a description of the critical and non-critical evaluation criteria (see Table 2-6) used by the Navy as the basis of its assessment of the alternatives in terms of relative operational merits. Table 2-6 reflects the critical and non-critical criteria used in the final OEIS/EIS evaluation process.

Subchapter 2.3.5 presents the evaluation of the alternative sites using these criteria. A summary of the results of the evaluation is contained in Subchapter 2.3.6.

Table 2-6

Final OEIS/EIS Site Evaluation Criteria

Critical Evaluation Categories and Criteria
Physiography *
Water Depth Range
Range Area Length/Width Ratio
Shallow/Deep Water Depth Ratio
Range Orientation to Shoreline
Adequacy of Support Infrastructure
Shore Landing Site for Trunk Cable
Helicopter Training And Recovery Support
Availability Based on Climatological Criteria
Visibility
Wind Speeds
Wave Height
Training Efficiency
Vessel Traffic (Commercial Shipping)
Non-Critical Evaluation Criteria
Proximity To Homeports/Air Stations
Helicopter Homeports/Air Stations
Surface Ship/Submarine Homeports
Range Installation and Use
Commercial Fishing
Ocean Currents
Bottom Type
Non-Critical Support Infrastructure
Air Space Control
CTF and Shore Landing Site
Proximity to Docking Facility For Range Support Craft
** Proximity to existing homeports was additionally used as an earlier criterion to determine logistical feasibility for candidate sites. At this point, the Gulf of Mexico site was eliminated from further consideration based on excessive distances and travel times from existing homeports.*

- **Critical criteria –** Critical criteria are the absolute physical requirements that, if not met, present insurmountable obstacles that preclude training operations on the range. There are no solutions, regardless of cost, for these criteria. Physiography is one of these criteria. A candidate site must provide the necessary range of water depths and balance of shallow and deep areas. The site must also have sufficient area within this span of water depths for a range of suitable size and appropriate orientation.

  If a candidate site cannot provide a location for a shore landing of the trunk cable and a helicopter landing site to support training and torpedo recovery, that site is unacceptable. Additionally, a site cannot be located in a region of the ocean where adverse weather limits the number of possible days of range operation. Finally, heavy commercial shipping or fishing traffic will render a site unsuitable due to the constraints that traffic would place on available operational time.

- **Non-critical criteria –** Other criteria if not met, can be overcome, although overcoming them would result in higher costs and, in some cases, diminished efficiency and effectiveness.

  Among these non-critical criteria is proximity to homeports and air stations. This is a major consideration but not one that would preclude training operations at sites that do not meet the criterion. The consequence of not being reasonably close to homeports and air stations would be longer transits to and from the range site. Longer transits would impact cost and scheduling efficiency proportionally to the increases in distance and time required for travel.

  Range installation criteria (i.e., bottom type, currents, presence of bottom fishing) do not preclude range installation if not met, but may require additional range installation craft or personnel, or ‘hardening’ of nodes to protect against bottom fishing. (‘Hardening’ is the integration of physical protection structures to prevent damage from bottom-fishing gear to the range instrumentation.) Non-critical support infrastructure criteria (i.e., proximity to range support craft) can also be overcome if not met, but at additional cost.

2.3.4.4 USWTR Critical Evaluation Criteria

Physiography

The physiography of the site affects the shape and location of the training range. The Navy requires an area of 1,713 km^2 (500 NM^2) for the USWTR. Shallow water is defined as from 37 to 274 m (120 to 900 ft) in depth for the purpose of naval training operations for USWTR. Off the U.S. east coast, this depth range generally is located in the continental shelf and continental slope regions. This requirement determined the sites chosen for further analysis.

Additional characteristics required of the range site include its shape, distance from landfall, distribution for water depth, and orientation. The optimal shape aspect is a 1:1 length-width ratio (square) located parallel to the coast and, therefore, generally parallel to the bathymetry contours. The optimal water space is balanced around the mid-water depth of 137 m (450 ft). Distance from landfall is optimally less than 93 km (50 NM) to minimize installation and operation costs.

- Preferred

  - encompasses water depths between 37 m (120 ft) and 274 m (900 ft) and substantially all of the area is within these depths.
  - length-width ratio of the site between 1:1 and 1:1.25 (nearly square).
  - portion of range above or below 137 m (450 ft) deep not less than one third of the total range area.
  - range oriented with long axis parallel to the coast.

  Essentially, the entire area of a range site needs to be within the desired water depths. However, if shallow water were available adjacent to an existing deep-water training range, the collocation of the shallow and deep water facilities would be sufficiently valuable to accept the 'satisfactory' rating for physiography.

- Satisfactory

  - encompasses water depths between 37 m (120 ft) and 274 m (900 ft) with sizeable areas deeper or shallower than this range .
  - portion of range above or below 137 m (450 ft) deep greater than one quarter but less than one third of the total range area.
  - length-width ratio of the site between 1:1.25 and 1:2 (roughly rectangular in shape; a large angle parallelogram is acceptable).
  - range oriented with the long axis roughly parallel to the coast.

- Unsatisfactory

  - lack of water depth between 37 m (120 ft) and 274 m (900 ft).
  - portion of range above or below 137 m (450 ft) deep fails to represent at least one quarter of the total range area.
  - length-width ratio of the site greater than 1:2.
  - long axis of the area not oriented roughly parallel to the coast.

Adequacy of Support Infrastructure

A variety of logistic support services are needed to operate and maintain the range, as well as to support training exercises.

Shore Landing Site for Trunk Cable

The cable landing site must provide sufficient ability for the installation vessel to navigate near shore for the cable installation and avoid the need to install the cable across areas subject to dredging or artificial reef placement, where material may be dumped to build the reef. The overall distance from the cable termination point to the range boundary must be of reasonable length to distribute power to the in-water instrumentation via conductors in the cable.

- Preferred
  - shore cable termination point within 93 km (50 NM) of range boundary.
  - no trunk cable crossing of artificial reefs or installation within an area that may be dredged. The placement of additional material for the reef or dredging could damage the cable.
  - ability of installation vessel to navigate within 0.9 km (0.5 NM) of the cable landing point.
- Satisfactory
  - shore cable termination point within 139 km (75 NM) of range boundary.
  - no trunk cable crossing of artificial reefs or installation within an area that may be dredged.
  - ability of installation vessel to navigate within 0.9 km (0.5 NM) of the cable landing point.
- Unsatisfactory
  - no shore cable termination point within 139 km (75 NM) of range.
  - trunk cable must cross artificial reefs or be installed within an area that may be dredged, such as a shipping channel.
  - extensive, non-navigable shallow water cable landing point areas where the installation vessel cannot approach closer than 0.9 km (0.5 NM).

Helicopter Training and Recovery Support

For ASW helicopters carrying an exercise torpedo and a load of sonobuoys, useful time on the range decreases proportionally with an increase in distance from its base or host ship. Recovery helicopters have limited flight range as well, affecting their ability to participate in long-distance training exercises and conduct target or torpedo launch and recovery operations from an airfield. Thus, the USWTR should be located proximal to that airfield. Commercial heavy lift helicopters are capable of recovery ranges up to 185 km (90 NM) for heavyweight torpedoes and MK 30 targets in favorable conditions, with 139 km (75 NM) used as the conservative range to account for weather and operational variability.

Helicopters carrying cable suspended loads during recovery operations are restricted from overflight of uncontrolled, occupied civilian areas, roads, and bridges. In lieu of direct transport to the airfield, an in-water drop point for the torpedoes and targets can be used in combination with a recovery vessel. This approach is more costly and logistically complex, since both helicopters and recovery vessels are required at all times. This approach was only investigated when the preferred option could not be met for a candidate site. The need for an in-water drop would change the ranking of a site from preferred to satisfactory for this factor, but would not necessarily preclude selection of the site.

- Preferred
  - local military airfield for helicopter training and torpedo or target launch and recovery operations within 139 km (75 NM) of entire range area.
  - direct access to the ocean with no over-flight of civilian areas, roads, and bridges between range site and airfield.
- Satisfactory
  - local military airfield or commercial airfield certified for helicopter training and torpedo or target handling within 185 km (90 NM) of the entire range area.
  - existing over-flight corridors between the range site and airfield along controlled access areas or shipping channels.
  - in-water drop point that can be defined for transfer of targets and torpedoes to a recovery vessel.
- Unsatisfactory
  - no local military airfield or commercial airfield certified for helicopter training and target or torpedo handling within 185 km (90 NM) of the entire range area.
  - over-flight of uncontrolled civilian areas, roads, and bridges required between range site and airfield.
  - lack of an in-water drop point for transfer of targets and torpedoes to a recovery vessel.

Availability Based on Climatological Criteria

The availability of a site for training is estimated in terms of the climatological criteria of visibility, wind speed, and wave height in the area. These criteria are not independent of each other; rather, they are related. For example, high wind speeds cause increased wave heights, and storms affecting visibility are accompanied by increased wind speeds and higher wave heights. Poor climatological conditions affect the training effectiveness of Navy range activities.

Operations involving EXTORPs typically are not conducted in foggy conditions or poor visibility conditions since vehicle recovery operations can not be performed with poor visibility.

Similarly, vehicle recovery operations for torpedoes and targets are increasingly difficult and dangerous as wave size and height increase. Such exercises are avoided in waves with heights of 3.7 m (12 ft) or higher. Sonar systems do not work accurately with excessive acoustic noise caused by high wind speeds and the resulting rough seas. Because range training exercises can be scheduled six months in advance, the Navy needs to be 95 percent sure the range will be available climatologically when it is needed.

- Preferred
  - mean monthly visibility equal to or less than 3.7 km (2 NM) less than 5 percent of the time.
  - mean monthly wind speed greater than or equal to 17 m/s (58 ft/s) less than 5 percent of the time.
  - mean wave height of 3.7 m (12 ft) or higher less than 5 percent of the time.
- Satisfactory
  - mean monthly visibility equal to or less than 3.7 km (2 NM) less than 15 percent of the time.
  - mean monthly wind speed greater than or equal to 17 m/s (58 ft/s) less than 15 percent of the time.
  - mean wave height of 3.7 m (12 ft) or higher less than 15 percent of the time.
- Unsatisfactory
  - mean monthly visibility equal to or less than 3.7 km (2 NM) more than 15 percent of the time.
  - mean monthly wind speed greater than or equal to 17 m/s (58 ft/s) more than 15 percent of the time.
  - mean wave height of 3.7 m (12 ft) or higher greater than 15 percent of the time.

Training Efficiency: Vessel Traffic (Commercial Shipping)

Some Navy operational activities, including use of exercise torpedoes, must avoid shipping vessels transiting through the range area. Because the range area is located in an exclusive economic zone, no disruption to commercial shipping can be imposed. For this reason, only a low level of commercial traffic is acceptable for a USWTR site, since such traffic disrupts or delays exercises and imposes additional expenses.

Commercial traffic was previously evaluated using the HITS database, which contains tanker and merchant ship traffic data for the four seasons of the year. The October 2005 draft OEIS/EIS assessed shipping traffic data from the HITS III database (1993), which provided shipping densities at a resolution of 1 degree of arc (longitude and latitude). At the latitudes of the USWTR candidate sites, this comprises an area of approximately 10,633 km^2 (3,100 NM^2). An upgrade to HITS, version 4.0, provides higher resolution data, defined by cells with sides with length of 5 minutes of arc (longitude and latitude) (Emery and Bradley, 2005). At the latitudes of the USWTR candidate sites, this area is approximately 72 km^2 (21 NM^2). The expected value for ship density in a given cell is an instantaneous figure representing the number of ships in that cell at any given moment (those entering a cell are considered to be equal to those leaving at any instant).

The HITS database was extensively analyzed in order to assess the density of shipping traffic in the candidate USWTR sites. In the course of this analysis, discrepancies were noted which raised concern about the accuracy of HITS and the suitability of its use for this purpose. In particular, known areas of high shipping traffic (e.g., the shipping lanes that go in and out of Boston) were not reflected in the HITS data. Because the HITS database only contains a limited number of ports, shipping traffic in the lanes from the excluded ports is not shown in its actual location. As the candidate USWTR sites are in the proximity of traffic lanes from major ports or coastal shipping lanes, these omissions were deemed serious enough to warrant using another source of shipping density data.

A report was obtained from NAVOCEANO (see Subchapter 2.3.4.2) that plots shipping data compiled over a five-year period. Examination of this report shows that it coincides precisely with known shipping lanes and high traffic density areas. This report, in contrast to the HITS data, provides the number of ships per day per unit area rather than an instantaneous snapshot. However, it is simple enough to deduce instantaneous ship numbers, if it is assumed that ship arrivals on the range site are uniformly distributed. For instance, if the average ship transit distance through the range site is assumed to be 86 km (25 NM) and the average transit speed is assumed to be 12.5 knots, a ship transiting through the range will, on average, remain there two hours (1/12 day). Thus, dividing the number of ships per day expected on the range site by 12 would yield the number that could be expected to be there at any given moment.

The analysis provided by NAVOCEANO was further supported by research at the University of Delaware, which provided another source of shipping intensity information. C. Wang et al. (2007) deemed the ICOADS and AMVER data set two of the best global ship traffic intensity proxies. These proxies draw self-reported samples from the global fleet and produce traffic intensity representations.

These representations, however, differ across regions. For example, in some areas, AMVER represents more tanker traffic, and ICOADS represents more container ship traffic. To remove the potential bias of using one data set over another, C. Wang et al. (2007) produced a third dataset, a combined proxy, by averaging the grid cell values (representing percent of global shipping emissions) of the ICOADS and AMVER proxies. The three spatial proxy datasets (C. Wang et al., 2007) have been made publicly available for the intended purpose of allowing users to apply the global ship emissions inventory of their choice to ship air-emissions impact models.

For the purposes of this OEIS/EIS, the spatial proxies give an estimate of shipping intensity within each of the range sites. The Navy analyzed the three shipping proxy datasets using GIS. The shipping emission values of the grid cells within each USWTR box were averaged, providing a relative estimate of shipping intensity. Each of the three proxy datasets provided similar results. The Gulf of Maine had a significantly lower shipping density than the other sites, as the NAVOCEANO report stated. The other sites, ranked in order of successively higher densities, are JAX, Charleston, VACAPES, and Cherry Point. Figure 2-10 depicts a plot of relative shipping densities in the USWTR sites, derived from the AMVER/ICOADS dataset.

The AMVER/ICOADS data enable the candidate sites to be compared, as each site has a precise value. While metric tonnes of emissions was deemed to be a reliable proxy for shipping density, metric tonnes of emissions cannot be directly translated into a meaningful ship traffic metric (i.e., ships per km^2 [NM^2] per day) for the purpose of this study. However, that proxy does serve a useful purpose in confirming the assessments the Navy made based on the NAVOCEANO data. While the data in the NAVOCEANO report are considered to be more reliable than the HITS data for this analysis, they do not provide precise shipping density numbers for a specific location. Instead, the data characterize areas of the ocean according to five density regimes (infrequent, light, moderate, heavy, very heavy).

- Preferred
  - ship traffic density on the range site fewer than 2 ships per day per 343 km^2 (100 NM^2).
  - major shipping lanes such as designated navigation channels for commercial ports do not intersect the range site.

- Satisfactory
  - light or moderate shipping traffic.
  - ship traffic density on the range site between 2-11 ships per day per 343 km^2 (100 NM^2).
  - major shipping lanes such as designated navigation channels for commercial ports do not intersect the range site.

- Unsatisfactory
  - heavy shipping traffic.

- ship traffic density on the range site greater than 11 ships per day per 343 km^2 (100 NM^2).
- major shipping traffic lanes such as designated navigation channels for commercial ports intersect the range site.

2.3.4.5 USWTR Non-Critical Evaluation Criteria

After assessment of critical characteristics, the sites were then rated preferred or non-preferred for the non-critical criteria. These ratings are used to evaluate the relative suitability of one site against another. As stated, a non-preferred rating for a non-critical criterion does not preclude the site from consideration, but a non-preferred rating would generally make one site less desirable than another in the category being assessed (a non-preferred rating means that making the site operationally viable would result in greater installation or operating costs).

Proximity to Homeports/Air Stations

All types of U.S. Navy ASW capable platforms will use the range. These currently are comprised of ASW capable surface ships (FFG/DDG/CG), submarines (attack [SSN, SSGN] and ballistic missile [SSBN]), ASW helicopters (MH-60R, SH-60B, SH-60F) and fixed wing aircraft (P-3, P-8). Helicopters are the predominant users of the range in terms of numbers and the dominant type will be the MH-60R. An MH-60R can travel approximately 556 km (300 NM), one way, without refueling to a forward site from which it could refuel and conduct ASW training. In a training environment, approximately 139 km (75 NM) is the maximum radius of action for flights in order to have sufficient time on the range for useful training. If the range is proximate to Jacksonville, no host surface ship or forward logistics base/airfield for ASW helicopters would be necessary. ASW fixed-wing aircraft (e.g., P-3C ASW patrol aircraft) have a minimum operating range of 6,115 km (3,300 NM).

A Record of Decision was issued on Decemebr 23, 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron (FRS) into the U.S. Navy Fleet. In 2012, the P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion at existing maritime patrol homebases. This action will result in the homebasing of five fleet squadrons (30 aircraft) and one Fleet Replacement Squadrons (FRS) (12 aircraft) to Naval Air Station (NAS) Jacksonville, Florida.

Surface ships and submarines generally transit at speeds between 15 and 17 knots. Thus, the transit time from their home ports to the range area can consume a significant percentage of allowable quarterly underway time. Every hour spent in transit is one hour less of training time spent on the range.

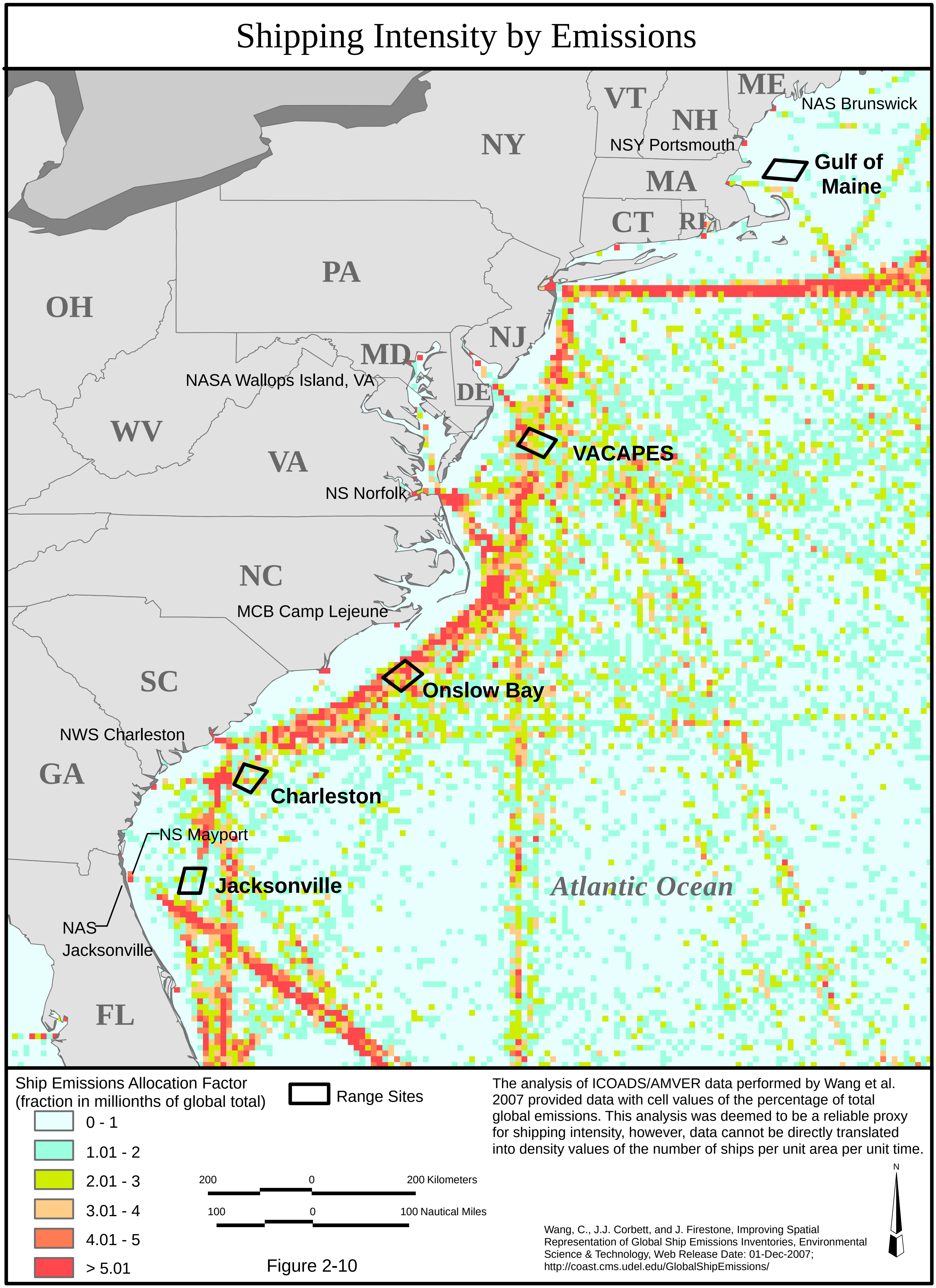

Shipping Intensity by Emissions
ME
VT
NH
NAS Brunswick
NY
NSY Portsmouth
Gulf of Maine
MA
CT
RI
PA
OH
NJ
MD
DE
NASA Wallops Island, VA
WV
VA
VACAPES
NS Norfolk
NC
MCB Camp Lejeune
SC
Onslow Bay
NWS Charleston
GA
Charleston
NS Mayport
Jacksonville
Atlantic Ocean
NAS Jacksonville
FL
Ship Emissions Allocation Factor (fraction in millionths of global total)
0 - 1
1.01 - 2
2.01 - 3
3.01 - 4
4.01 - 5
> 5.01
Range Sites
200 0 200 Kilometers
100 0 100 Nautical Miles
The analysis of ICOADS/AMVER data performed by Wang et al. 2007 provided data with cell values of the percentage of total global emissions. This analysis was deemed to be a reliable proxy for shipping intensity, however, data cannot be directly translated into density values of the number of ships per unit area per unit time.
N
Wang, C., J.J. Corbett, and J. Firestone, Improving Spatial Representation of Global Ship Emissions Inventories, Environmental Science & Technology, Web Release Date: 01-Dec-2007; http://coast.cms.udel.edu/GlobalShipEmissions/

Figure 2-10

Helicopter Homeports/Air Stations

- Preferred for helicopters: home air stations within 556 km (300 NM) of the local military airfield.

- Non-preferred for helicopters: no helicopter home air stations within 556 km (300 NM) of the local military airfield.

Surface Ship/Submarine Homeports

- Preferred for surface ships and submarines: surface ship/submarine homeports within 648 km (350 NM) of the range.

- Non-preferred for surface ships and submarines: no surface ship/submarine homeports within 648 km (350 NM) of the range.

Range Installation and Use

Commercial Fishing

Commercial fishery activities have the potential to interrupt range activities. While commercial fishing is nearly impossible to avoid on the continental shelf and in the continental slope region, areas of minimal commercial bottom fishing are preferred. Naval training exercises do not interrupt commercial fishing activities, as areas of commercial fishing cannot in any way be restricted by the Navy. However, the presence of commercial fishing activities may interrupt Navy training exercises, resulting in lower training efficiency and impacting scheduling. Because range training exercises can be scheduled six months in advance, the Navy needs to be sure the range will be available without persistent conflict from fishing activity.

The types of gear used by the various commercial fisheries also affect the range in-water system. Bottom-dragged gear (e.g., bottom trawls, anchors, and dredges) may have an adverse affect on the USWTR's bottom-mounted instruments and cables. In fact, instrumentation can be designed, manufactured, and installed to protect sensors from dragged gear, and trunk and internode cabling can be trenched and buried if this type of fishing is expected. These protective measures, however, would impose substantial additional costs.

- Preferred

  - minimal presence of commercial fishing activity.
  - commercial fishing conducted solely within the water column.
  - no requirement for sensor protection and internode cable burial within the range area.

- Non-preferred
  - substantial commercial fishing activity in range area.
  - extensive use of bottom-trawling gear and commercial dredging.
  - sensor protection and/or internode cable burial required.

Ocean Currents

Ocean currents are a significant criterion in the range installation activities. Cable installations are normally conducted at low vessel speeds of less than two knots, with an average of one knot being typical. There is a need for periodic station-keeping, where the ship maintains its position around a fixed position, during some installation events, such as the deployment of sensor nodes or junction boxes into the ocean. Increasing ocean currents make it more difficult for the installation vessel to navigate and control its position and raise the risk level for damage to the cables and instrumentation. In higher currents, a vessel with greater navigational control may be required. This decreases the availability of capable installation vessels and increases the overall installation cost to the program for the leasing of these ships.

- Preferred: ocean currents less than 0.5 m/s (1.6 ft/s).

- Non-preferred: ocean currents greater than 0.5 m/s (1.6 ft/s).

Bottom Type

A wide range of criteria affect the range installation. Generally, these most directly impact cost. Cable landing across broad shallow water areas where the installation vessel cannot navigate, such as tidal flats and marsh areas, must be avoided or bypassed using directional drilling. Rocky bottom regions require higher power trenching equipment to bury cables, when this is necessary. Areas with ridges, canyons, or other discontinuities can influence cable routes and sensor placement and presents installation risks to equipment.

- Preferred: soft, sandy bottom.

- Non-preferred: solid, hard-bottom area with no variability, or varied bottom with sand.

Non-Critical Support Infrastructure

Air Space Control

For training exercise safety, it is preferred that the range area and a large buffer area surrounding the range be free from commercial and civilian aircraft intrusion. Much of the U.S. east coast continental shelf area is overlaid with established air warning areas that allow air traffic controllers to route commercial aircraft around the range area.

- Preferred:

  - existing DoN air warning area with unrestricted schedule use from the surface to minimum of 7,766 m (24,000 ft) over and around the range area.
  - air warning areas under a common DoD scheduling and control authority extending over and around the range area, or warning area(s) under USAF / NASA control extending over and around the range area.

- Non-preferred:

  - no existing warning areas over and around the range area.
  - no potential to create a warning area due to civilian or commercial air routes and activities requiring coordination with civilian and commercial flights.

CTF and Shore Landing Site

Controlled access to the CTF property such as that available at a military base is highly desirable to ensure the integrity of the electronics systems and infrastructure. Alternatively, facilities can be constructed at additional cost if access to the CTF by the general public cannot be controlled.

- Preferred: a DoD facility for the shore cable termination point and siting of the CTF with controlled physical access to property and cable landing site with a security force in place at all times.

- Non-preferred: no existing DoD or federal shore facility for the cable termination point and siting of the CTF.

Proximity to Docking Facility for Range Support Craft

A docking facility, preferably nearby, is required for the range support craft used in target deployment and for target and torpedo recovery. The docking facility must be able to handle on/off-load of materials and equipment. This includes a heavy lift capacity of up to 4,536 kg (10,000 lbs) for targets and exercise torpedoes and up to 18,144 kg (40,000 lbs) for standard-size shipping containers. Also, ready access to road or rail is needed for weapon/target post-run processing and transportation to the appropriate maintenance facility for equipment maintenance and refurbishment. Proximity of the docking facilities to the range area moderates operational support costs for range support vessels over the operating life of the range. Torpedo recovery vessels are also smaller than warships and not equipped to spend extended times at sea (i.e., typically less than a week), necessitating the need for a nearby port.

- Preferred
  - proximate, available military or commercial docking facilities within 133 km (72 NM) of the range center (this corresponds to a vessel transit speed of 12 knots for 6 hours).
  - heavy materials handling capability for both targets and exercise torpedoes and standard-size shipping containers.
  - transportation infrastructure options available: overland trucking combined with air or sea or rail services.

- Non-preferred
  - limited capacity or no military or commercial docking facilities.
  - no heavy materials handling capability or transportation infrastructure, including overland trucking. This would mean that there would be inadequate/nonexistent logistic support infrastructure to handle range requirements at such a facility.

2.3.5 Evaluation Results for the Candidate Sites

The candidate sites were evaluated against the critical and non-critical criteria and subcriteria discussed in the Subchapters 2.3.4.3, 2.3.4.4, and 2.3.4.5, and reflected in Table 2-6. The sites were ranked as preferred, satisfactory, or unsatisfactory for the critical criteria. A rating of unsatisfactory in a critical criterion means the candidate site cannot meet the specifications of the Navy’s operational requirements document for the USWTR range, regardless of cost, and hence cannot be recommended as a potential site.

The sites were then rated preferred or non-preferred for the non-critical criteria. Ratings for non-critical criteria were used as part of the Fleet assessment process (see Figure 2-8) to evaluate the relative suitability of one site compared to another. Although a rating of non-preferred would not preclude a particular site from consideration, the site could still be considered undesirable; to overcome the condition that generated the non-preferred rating would result in greater installation and/or operating costs.

The ratings and results are determined as follows:

- If a criterion contains an even number of subcriteria and there is a tie, the overall result (taking a conservative approach) would be obtained by selecting the lower of the two ratings for the subcriteria.

  For example, for the critical evaluation criterion Adequacy of Support Infrastructure, both the JAX and Charleston proposed OPAREA sites are rated satisfactory because one of the two subcriteria for each site was rated satisfactory rather than preferred.

- If the evaluation criterion comprises an odd number of subcriteria, the majority rating of the subcriteria prevails for the overall evaluation factor.

2.3.5.1 Site A - JAX OPAREA

Critical Evaluation Criteria

Physiography: *Preferred*. The water depth extends from approximately 120 ft to 1200 ft and is nearly all between the depths of 120 ft and 900 ft. The ratio of water depth above and below 450 ft deep is 66 percent to 34 percent, respectively. The site is a parallelogram measuring approximately 26.3 NM by 19.3 NM with a length to width ratio of 1.36. The long axis of the range area is oriented roughly parallel to shore. The site meets the preferred conditions for the water depth range, shallow/deep water depth ratio and range orientation to shore. The site is satisfactory for the range area length/width ratio.

Adequacy of Support Infrastructure: *Satisfactory*. The proposed USWTR site is 1.9 km (1 NM) beyond the suggested limit for a preferred rating in terms of shore cable landing (NS Mayport is 94 km [51 NM] from the western edge of the site), so the JAX USWTR site has a satisfactory rating for this subcriterion. The site meets the preferred conditions for helicopter training and recovery support. NS Mayport and NAS Jacksonville have ASW helicopter pads to support proposed USWTR operations. NS Mayport borders the Atlantic Ocean, eliminating the need for overflight of civilian areas.

Availability Based on Climatological Criteria: *Preferred*. The mean monthly occurrence of low visibility never exceeds 5 percent of the time. High mean monthly wind speeds (17 m/s [58 ft/s]) never exceed 5 percent of the time. The site experiences three months where wave heights exceed 3.7 m (12 ft) on average at least 5 percent of the time, but the 15 percent level is never exceeded.

Training Efficiency: Vessel Traffic (Commercial Shipping)**:** *Satisfactory***.** Shipping traffic is light (shipping density on the range site equals 2-11 ships per day per 343 km^2 [100 NM^2]).

Non-Critical Evaluation Criteria

Proximity to Homeport/Home Air Station: *Preferred.* JAX meets the preferred conditions for this evaluation criterion for aircraft, submarines, and ships. A Record of Decision was issued on Decemebr 23, 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron (FRS) into the U.S. Navy Fleet. In 2012, the P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion at existing maritime patrol homebases. This action will result in the homebasing of five fleet squadrons (30 aircraft) and one Fleet Replacement Squadrons (FRS) (12 aircraft) to Naval Air Station (NAS) Jacksonville, Florida.

Submarines and surface ships are all within preferred distances. Of the 55 east coast surface ships with hull-mounted ASW sonars, more than half are homeported at Mayport. Additionally, all east coast ballistic submarines and guided missile submarines are homebased at Kings Bay, a short distance north up the coast.

Range Installation and Use: *Preferred.* The site is subject to heavy use of commercial fishing gear and is non-preferred for that factor. The site is preferred for the other two subcriteria in this evaluation factor. It is on the boundary of the Florida Current and the bottom type conditions are sand/fine gravel.

Non-Critical Support Infrastructure: *Preferred.* The site meets the preferred conditions for all three subcriteria.

2.3.5.2 Site B - Charleston OPAREA

Critical Evaluation Criteria

Physiography: *Preferred*. The water depth extends from approximately 120 ft to 1000 ft and is nearly all between the depths of 120 ft and 900 ft. The ratio of water depth above and below 450 ft deep is 66 percent to 34 percent, respectively. The site is a quadrangle measuring an average of 24.7 NM by 19.7 NM with a length to width ratio slightly greater than 1.25. The long axis of the range area is oriented roughly parallel to shore. The site meets the preferred conditions for the water depth range, shallow/deep water depth ratio and range orientation to shore. The site is satisfactory for the range area length/width ratio.

Adequacy of Support Infrastructure: *Satisfactory*. The site meets the preferred conditions for a shore trunk cable landing site; Fort Moultrie is 74 km (40 NM) from the western edge of the site. It is rated satisfactory in terms of helicopter training and recovery because an in-water drop would need to be established to avoid overflight of populated areas.

Availability Based on Climatological Criteria: *Preferred*. The mean monthly occurrence of low visibility does not exceed 5 percent of the time. Occurrence of high mean monthly wind speeds (17 m/s [58 ft/s]) does not exceed 5 percent of the time. However, wave heights exceed 3.7 m (12 ft) on average at least 5 percent of the time during eight months of the year, and the 15 percent level is equaled in February.

Training Efficiency: Vessel Traffic (Commercial Shipping): *Satisfactory*. Shipping traffic is light (shipping density on the range site equals 2-11 ships per day per 343 km^2 [100 NM^2]).

Non-Critical Evaluation Criteria

Proximity to Homeport/Home Air Station: *Preferred*. Helicopters and other aircraft based at Jacksonville are within the preferred distance from the Charleston USWTR site (556 km [300 NM]). Surface ships and submarines are all within preferred distances of homeports.

Range Installation and Use: *Preferred*. The bottom type conditions are sand, the currents at the bottom are about 0.7 m/s (2.3 ft/s), and the site meets the preferred criteria for commercial fishing gear.

Non-Critical Support Infrastructure: *Preferred*. The site meets the preferred conditions for all three subcriteria.

2.3.5.3 Site C - Cherry Point OPAREA

Critical Evaluation Criteria

Physiography: *Preferred*. The water depth extends from approximately 131 ft to 1,319 ft and is nearly all between the depths of 120 ft and 900 ft. The ratio of water depth above and below 450 ft deep is 63 percent to 37 percent, respectively. The site is a rectangle measuring 25 NM by 20 NM with a length to width ratio of 1.25. The long axis of the range area is oriented roughly parallel to shore. The site meets the preferred conditions for the water depth range, shallow/deep water depth ratio, range area length/width ratio and range orientation to shore.

Adequacy of Support Infrastructure: *Preferred.* The site meets the preferred subcriteria for the shore cable landing site and for helicopter training and recovery support. Marine Corps Air Station (MCAS) New River on Camp Lejeune, North Carolina, is approximately 105 km (57 NM) from the range center. MCAS Cherry Point, North Carolina, is approximately 120 km (65 NM) from the range center. The two MCASs currently support extensive helicopter operations.

Availability Based on Climatological Criteria: *Satisfactory*. The mean monthly occurrence of low visibility does not exceed 5 percent of the time. High mean monthly wind speeds (17 m/s [58 ft/s]) that occur at least 5 percent of the time are experienced in January and February, but not more than 15 percent of the time. The site experiences eight months where wave heights of 3.7 m

(12.1 ft) or higher prevail on average at least 5 percent of the time, but the 15 percent level is only exceeded in February.

Training Efficiency: Vessel Traffic (Commercial Shipping)*: Satisfactory*. Shipping traffic is light (shipping density on the range site equals 2-11 ships per day per 343 km^2 [100 NM^2]).

Non-Critical Evaluation Criteria

Proximity to Homeport/Air Station: *Non-preferred*. Helicopters, the driver in evaluating proximity to homeports, and other aircraft based at Jacksonville, NC are farther than the preferred distance from the local airport that would support this USWTR site (556 km [300 NM]). Surface ship and submarine homeports are all within preferred distances of the proposed site.

Range Installation and Use: *Preferred.* The site is preferred for two subcriteria, commercial fishing volume and bottom type conditions (sand/hard bottom). The site is non-preferred in terms of ocean currents. Bottom currents can range up to 0.5 m/sec (1.6 ft/sec) and surface currents are on the order of 1.0 m/s (3.3 ft/s) or greater due to meanders of the Gulf Stream that can cross the range site.

Non-Critical Support Infrastructure: *Preferred*. The site meets the preferred conditions for all three subcriteria.

2.3.5.4 Site D - VACAPES OPAREA

Critical Evaluation Criteria

Physiography: *Satisfactory*. The water depth extends from approximately 120 ft to 3000 ft. Approximately one tenth of the area lies at a depth greater than 900 ft. The ratio of water depth above and below 450 ft deep is 73 percent to 27 percent, respectively. The site is a rectangle measuring 25 NM by 20 NM with a length to width ratio of 1.25. The long axis of the range area is oriented roughly perpendicular to shore. The site meets the preferred conditions for the range area length/width ratio. The water depth range, shallow/deep water depth ratio and range orientation to shore are satisfactory.

Adequacy of Support Infrastructure: *Preferred.* The site meets the preferred rating subcriteria for the shore trunk cable landing site and for helicopter training and recovery services support. The nearest secure federal airfield, Virginia's NASA WFF, approximately 82 km (44 NM) from the center of the candidate site, does support helicopter operations, and because this facility borders the Atlantic Ocean, overflight of civilian areas would not be required.

Availability Based on Climatological Criteria: *Satisfactory*. Three months of the year, the mean monthly occurrence of low visibility exceeds 5 percent, but by less than a percentage point. High mean monthly wind speeds do not occur more than 5 percent of the time in any month.

Wave heights at the site exceed 3.7 m (12 ft) on average 5 percent of the time in at least eight months, but not more than 15 percent.

Training Efficiency: Vessel Traffic (Commercial Shipping): *Satisfactory*. Shipping traffic is light (shipping density on the range site equals 2-11 ships per day per 343 km^2 [100 NM^2]).

Non-Critical Evaluation Criteria

Proximity to Homeport/Air Station: *Non-preferred.* Helicopters and other aircraft based at Jacksonville are farther than the preferred distance from the local airfield that would support this USWTR site (556 km [300 NM]). Surface ship and submarine homeports are all within preferred distances of the site.

Range Installation and Use: *Preferred*. The site meets preferred conditions for bottom type (sand) and currents (0.1 – 0.4 m/s [0.3 – 1.3 ft/s] at the bottom). However, the site is subject to heavy use of commercial fishing gear and bottom fishing and is therefore rated non-preferred for this subcriterion.

Non-Critical Support Infrastructure: *Preferred*. The site meets the preferred conditions for all three subcriteria.

2.3.5.5 Site E - Gulf of Maine

Critical Evaluation Criteria

Physiography: *Preferred*. The water depth extends from approximately 120 ft to 900 ft and is nearly all between the depths of 120 ft and 900 ft. The ratio of water depth above and below 450 ft deep is 57 percent to 43 percent, respectively. The site is a parallelogram measuring 25 NM by 20 NM with a length to width ratio of 1.25. The long axis of the range area is oriented roughly parallel to the tip of Cape Cod, though the shore line is an irregular shape. The site meets the preferred conditions for the water depth range, shallow/deep water depth ratio and range area length/width ratio. The range site orientation to shore is satisfactory.

Adequacy of Support Infrastructure: *Preferred.* The site is rated preferred for the shore trunk cable landing. The CTF would be located at Portsmouth Naval Shipyard, a major naval installation approximately 65 km (35 NM) from the candidate site. The site is preferred in terms of helicopter training and recovery support. The Provincetown Airport, approximately 55 km (30 NM) from the range center, can be used for torpedo and target recovery and currently is used in support of open ocean exercises.

Availability Based on Climatological Criteria: *Unsatisfactory*. While the site meets satisfactory wind speed and wave height criteria, the mean monthly occurrence of low visibility exceeds 5 percent in every month of the year and exceeds 15 percent in three months of the year.

Training Efficiency: Vessel Traffic (Commercial Shipping): *Preferred.* Shipping traffic is infrequent (shipping density on the range site equals less than two ships per day per 343 km^2 [100 NM^2]).

Non-Critical Evaluation Criteria

Proximity to Homeport/Air Station: *Non-preferred.* Surface ships and submarines are largely within preferred distances, but the closest helicopter home air station to the Gulf of Maine exceeds the 556-km (300-NM) distance parameter.

Range Installation and Use: *Preferred*. The site is preferred for bottom type conditions (sand/gravel) and currents (0.1 – 0.2 m/s [0.3 – 0.7 ft/s] at the bottom). However, because the site is subject to heavy bottom fishing with commercial fishing gear, it is considered non-preferred for the commercial fishing subcriterion.

Non-Critical Support Infrastructure: *Preferred*. The site is non-preferred in terms of air space control. It is preferred in terms of the CTF/shore landing site and docking facilities, available at Boston, Massachusetts, and Portsmouth, New Hampshire.

2.3.6 Summary of Ratings for Each Site

Table 2-7 contains a summary of the conclusions for each evaluation criteria. The sites in the JAX (Site A), Charleston (Site B), Cherry Point (Site C), and VACAPES (Site D) OPAREAs were rated satisfactory or preferred for all of the critical evaluation criteria and were therefore carried forward in the evaluation. The Gulf of Maine (Site E) was rated unsatisfactory for one of the critical evaluation criteria and was eliminated from further consideration.

2.4 Selection of the Preferred Alternative

The JAX OPAREA USWTR site (Site A) has been designated as the operationally preferred USWTR site alternative. The foundation of this selection is the evaluation criteria rating process described in Subchapter 2.3. Using the ratings as the basis for assessing the relative operational merits of each site, the Navy determined that the proposed Jacksonville site was the most suitable for meeting the Navy’s operational needs.

The JAX OPAREA USWTR range site alternative offers preferred conditions for two of the critical evaluation criteria (physiography and availability based on climatological criteria) and is satisfactory in terms of adequacy of support infrastructure and training efficiency relative to vessel traffic. For non-critical evaluation criteria, Jacksonville is rated preferred for all three subcriteria.

Table 2-7

Evaluation Criteria for Each Site

Quantitative Parameter	**JAX OPAREA**	**Charleston OPAREA**	**Cherry Point OPAREA**	**VACAPES OPAREA**	**Gulf of Maine OPAREA**
Critical Evaluation Criteria					
Physiography	**Preferred**	**Preferred**	**Preferred**	**Satisfactory**	**Preferred**
Water Depth Range	Preferred	Preferred	Preferred	Satisfactory	Preferred
Range Area Length/Width Ratio	Satisfactory	Satisfactory	Preferred	Preferred	Preferred
Shallow/Deep Water Depth Ratio	Preferred	Preferred	Preferred	Satisfactory	Preferred
Range Orientation to Shoreline	Preferred	Preferred	Preferred	Satisfactory	Satisfactory
Adequacy of Support Infrastructure	**Satisfactory**	**Satisfactory**	**Preferred**	**Preferred**	**Preferred**
Shore Landing Site for Trunk Cable	Satisfactory	Preferred	Preferred	Preferred	Preferred
Helicopter Training and Recovery Support	Preferred	Satisfactory	Preferred	Preferred	Preferred
Availability Based on Climatological Criteria	**Preferred**	**Preferred**	**Satisfactory**	**Satisfactory**	**Unsatisfactory**
Visibility	Preferred	Preferred	Preferred	Satisfactory	Unsatisfactory
Wind Speeds	Preferred	Preferred	Satisfactory	Preferred	Satisfactory
Wave Height	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory

Table 2-7 (cont'd)

Evaluation Criteria for Each Site

Quantitative Parameter	**JAX OPAREA**	**Charleston OPAREA**	**Cherry Point OPAREA**	**VACAPES OPAREA**	**Gulf of Maine OPAREA**
Training Efficiency ***Vessel Traffic (Commercial Shipping))***	**Satisfactory**	**Satisfactory**	**Satisfactory**	**Satisfactory**	**Preferred**
Non-Critical Evaluation Criteria					
Proximity to Homeports/Air Stations	**Preferred**	**Preferred**	**Non-preferred**	**Non-preferred**	**Non-preferred**
Helicopter Homeport/Air Stations	Preferred	Preferred	Non-preferred	Non-preferred	Non-preferred
Surface Ship/ Submarine Homeports	Preferred	Preferred	Preferred	Preferred	Preferred
Range Installation and Use	**Preferred**	**Preferred**	**Preferred**	**Preferred**	**Preferred**
Commercial Fishing	Non-preferred	Preferred	Preferred	Non-preferred	Non-preferred
Ocean Currents	Preferred	Preferred	Non-preferred	Preferred	Preferred
Bottom Type	Preferred	Preferred	Preferred	Preferred	Preferred
Non-Critical Support Infrastructure	**Preferred**	**Preferred**	**Preferred**	**Preferred**	**Preferred**
Air Space Control	Preferred	Preferred	Preferred	Preferred	Non-preferred
CTF and Shore Landing Site	Preferred	Preferred	Preferred	Preferred	Preferred
Proximity to Docking Facility for Range Support Craft	Preferred	Preferred	Preferred	Preferred	Preferred
Note: Subcriteria appear in italics					

Subcriteria within the critical and non-critical evaluation criteria differ in terms of the potential for impact on accomplishing training objectives, on efficiency, and on the cost of solutions to overcome less-than-perfect situations. For example, both JAX and Charleston are rated satisfactory for the critical evaluation factor, Adequacy of Infrastructure Support. However, the differentiators between the two sites are the subcriteria that generated the overall rating. For JAX, the distance from the shore landing site for the trunk cable to the USWTR site was what resulted in the overall satisfactory rating for the critical evaluation factor. That distance (94 km [51 NM]) is just 1.9 km (1 NM) over the preferred parameter (93 km [50 NM]), but enough to generate a satisfactory rather than a preferred rating. The impact to the Navy relative to that extra distance would primarily be increases in cost.

On the other hand, Charleston was rated preferred in terms of distance to the shore cable landing site but satisfactory in terms of subcriteria defining helicopter training and recovery support activities. Because these activities are crucial to the integral success of the training exercises, the Navy, when considering the ratings of these two subcriteria – distance to trunk cable landing site and helicopter training and recovery support – as part of its decision making, would assess carefully which subcriterion could have the greatest negative impact.

Additional considerations that were a part of the final analysis of operational effectiveness were:

- Which platform type (aviation, ship, or submarine) anticipates being the most frequent user of the facility?
- What is/are the homebase/homeport location(s) of the primary user?

The largest anticipated user of USWTR is the aviation community. A Record of Decision was issued on Decemebr 23, 2008 to provide facilities and functions to support homebasing 12 P-8A Multi-Mission Maritime Aircraft (MMA) squadrons and one Fleet Replacement Squadron (FRS) into the U.S. Navy Fleet. The P-8A MMA will replace the current maritime patrol aircraft, the P-3C Orion at existing maritime patrol homebases. This action will result in the homebasing of five fleet squadrons (30 aircraft) and one Fleet Replacement Squadrons (FRS) (12 aircraft) to Naval Air Station (NAS) Jacksonville, Florida. In terms of operational viability of USWTR, collocating the range facility in the same area as the primary user represents the greatest efficiency in applying limited resources to support training. In the 2005 draft OEIS/EIS, the Cherry Point USWTR was the identified operationally preferred alternative. However, with the decision to base the MMA and FRS squadrons at NAS Jacksonville, the presence of all east coast P-3s at NAS Jacksonville due to BRAC-95, and the decision to base all east coast ASW helicopters at NS Mayport and NAS Jacksonville, the JAX USWTR (Site A) is the operationally preferred alternative.

2.5 EIS Alternatives

As previously described in Subchapter 2.3, the site selection process narrowed the action alternatives down to four alternative sites, located within existing operating areas:

- Alternative/Site A in the JAX OPAREA
- Alternative/Site B in the Charleston OPAREA
- Alternative/Site C in the Cherry Point OPAREA
- Alternative/Site D in the VACAPES OPAREA.

These four alternative sites, along with the No Action Alternative, are presented as the OEIS/EIS alternatives. As stated in Subchapter 2.4, Site A in the JAX OPAREA is the Navy's preferred alternative.

All of the sites have the following characteristics in common (deviations are noted in the following sections).

- The sites comprise only a small portion of the OPAREAs in which they are located.

- Installation of the USWTR at the proposed sites would entail the placement of approximately 300 transducer nodes in water depths ranging from approximately 37 to 274 m (120 to 900 ft), over an approximate 1,713-km^2 (500-NM^2) area. The total bottom area covered by these components would be approximately 3,000 m^2 (32,300 ft^2); this is about 0.000002 percent of the area of the range.

- The interconnect cable between each node would be buried if deemed necessary at individual locations within a range. The decision to bury would be based on activities that interact with the bottom, such as anchoring and extensive use of bottom-dragged fishing gear. If the interconnect cable is not buried, the area impacted by the cable would be 27,500 m^2 (295,900 ft^2); this is about 0.00002 percent of the area of the range. If the interconnect cable is buried, the area impacted by the cable installation would be about 5,500,000 m^2 (59,180,000 ft^2) this is about 0.003 percent of the area of the range.

- A junction box located at the edge of the range would connect the interconnect cables with the trunk cable. Installation of the junction box would impact an area of about 30 m^2 (523 ft^2).

- A trunk cable connecting the range to the shore facilities would be buried (including within U.S. territory) to a depth of approximately 0.5 to 1 m (1 to 3 ft) and would run from the shore to a junction box located at the edge of the range (the cable would be buried, the junction box would not).

- 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, starting from the undersea exit point of the conduit. To bury the trunk cable, a 10 cm (4 in) wide trench would be excavated to a depth of about 0.5 to 1 m (1 to 3 ft) using a tracked, remotely operated cable burial vehicle that is approximately 5 m (16 ft) in width. Installation of the trunk cable would impact about 500,000 m^2 (5,380,000 ft^2) of the ocean bottom; this is about 0.0003 percent of the area of the range.

- If the interconnect cables are buried, the total impact to the ocean bottom would be 5,500,000 m^2 (59,180,000 ft^2); this is about 0.003 percent of the area of the range. If the interconnect cables are not buried, the total impact to the ocean bottom would be 27,500 m^2 (295,900 ft^2); this is about 0.00002 percent of the area of the range. See Table 2-1 for a summary of the impacts of the range installation to the ocean bottom.

- The trunk cable would be brought on shore in conduit using directional drilling techniques. From the land side termination point of the conduit to the CTF, the cable would be installed in a 0.6 m (2 ft)-wide, 0.9 m (3 ft)-deep trench.

- The CTF would be an approximately 37 m^2 (400 ft^2) structure that would house the power supplies, system electronics, and communications gear necessary to operate the offshore range.

- Communications signals would be routed from the range through the CTF to the range operations center at FACSFAC JAX for Site A and Site B or FACSFAC VACAPES for Site C and Site D. Electronics would be housed at the terminal end of the communications link.

2.5.1 Site A

The proposed Site A USWTR would be located offshore of northeastern Florida (Figure 2-11). The Site A range concept is shown in Figure 2-12. The center of the range would be approximately 106 km (57 NM) from shore in the JAX OPAREA.

The trunk cable would run approximately 94 km (51 NM) from the junction box near the edge of the range to land at NS Mayport (Figure 2-13). The shoreside trunk cable conduit would be installed under the dunes to the east of the CTF, with the seaward end of the conduit connected to underground cable in a trench (Figure 2-14).

Commercial power and telecommunications connections would be made from the CTF to the NS Mayport infrastructure.

2.5.2 Site B

The proposed Site B USWTR would be located offshore of Charleston, South Carolina (Figure 2-15). The Site B range concept is shown in Figure 2-16. The center of the range would be approximately 96 km (52 NM) from shore in the Charleston OPAREA.

The trunk cable would run approximately 83 km (45 NM) from the junction box near the edge of the range to land at Fort Moultrie National Monument (Figure 2-17). The trunk cable conduit at Site B would be installed similarly to Site A, under the dunes to the east of the CTF with the seaward end of the conduit connected to underground cable in a trench (Figure 2-18).

Commercial power and telecommunications connections would be made from the CTF to facilities at the Fort Moultrie National Monument.

2.5.3 Site C

The Site C USWTR would be located offshore of southeastern North Carolina within the Cherry Point OPAREA (Figure 2-19). The Site C range concept is shown in Figure 2-20. The center of the range would be approximately 89 km (48 NM) from shore.

The trunk cable would run approximately 86 km (47 NM) from the junction box near the edge of the range to the beach (Figure 2-21). Onshore, the trunk cable conduit would run under the dunes, the existing roadways, and the Intracoastal Waterway to a CTF located near Onslow Beach, Camp Lejeune (Figure 2-22).

Data signals from the CTF would be sent via microwave transmitter on the Onslow North Tower to the Starling communication site at MCB Camp Lejeune, and then onward to FACSFAC VACAPES over the existing microwave data link.
Commercial power and telecommunications connections would be made from the CTF to the MCB Camp Lejeune infrastructure.

2.5.4 Site D

The USWTR would be located offshore of the northeastern coast of Virginia (Figure 2-23). The Site D range concept is shown in Figure 2-24. The center of the range would be approximately 85 km (46 NM) from shore in the VACAPES OPAREA.

The trunk cable would run approximately 85 km (46 NM) from the junction box near the edge of the range to shore, to a CTF at the NASA WFF (Figure 2-25). The shoreside trunk cable conduit would be installed under the dunes to the east of the CTF, with the seaward end of the conduit

Site A Range Within the Jacksonville OPAREA

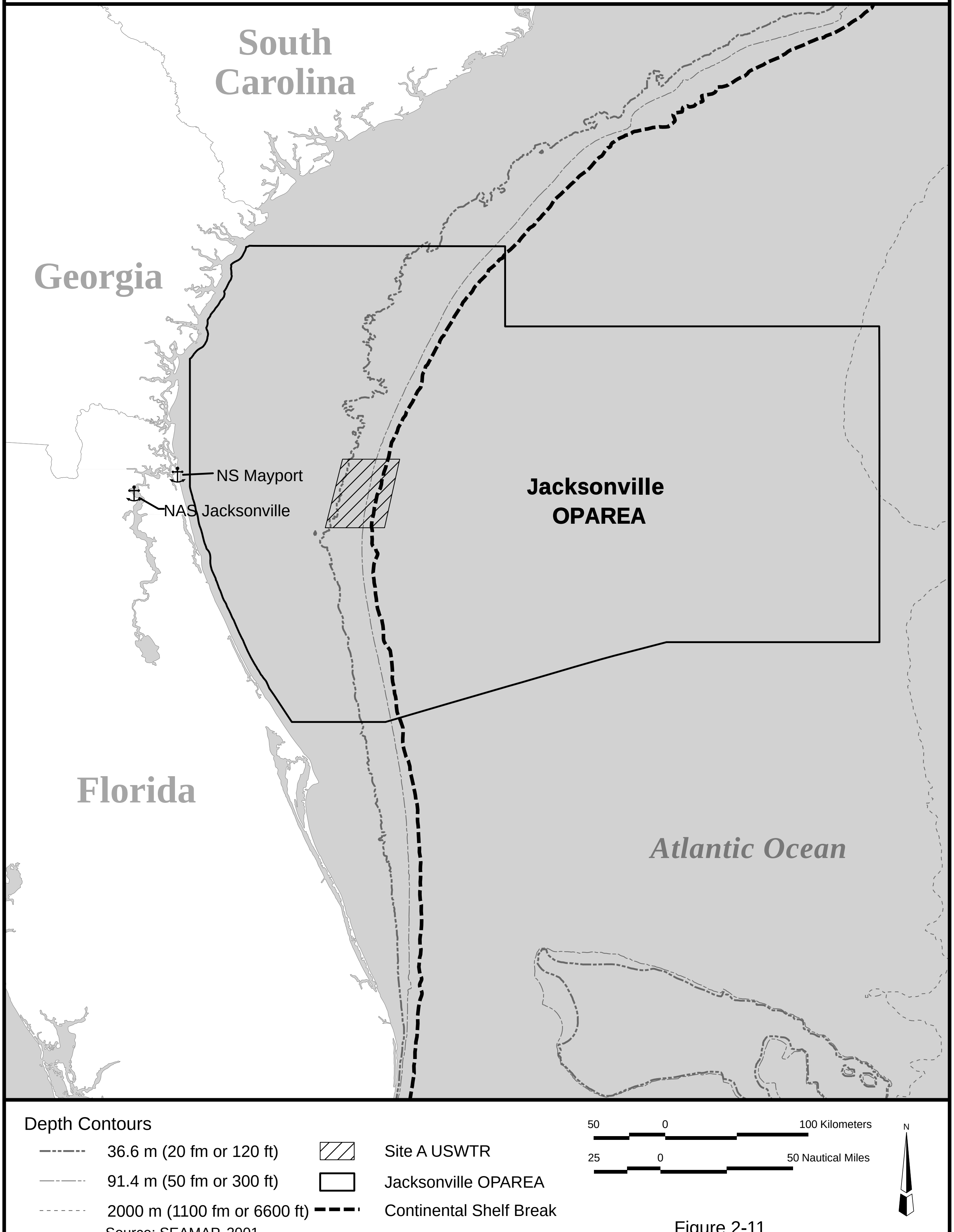


Figure 2-11

Site A Range Concept

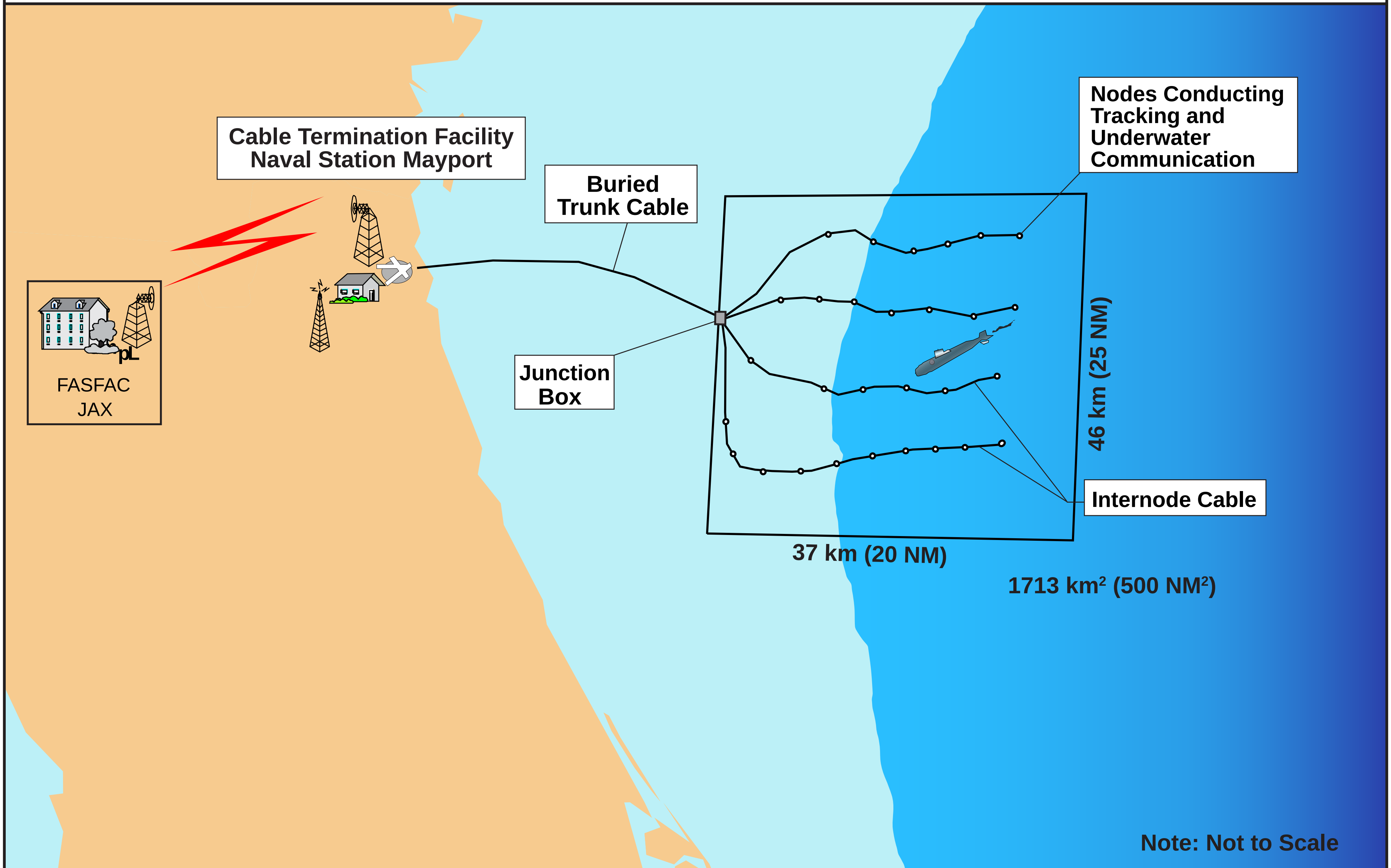
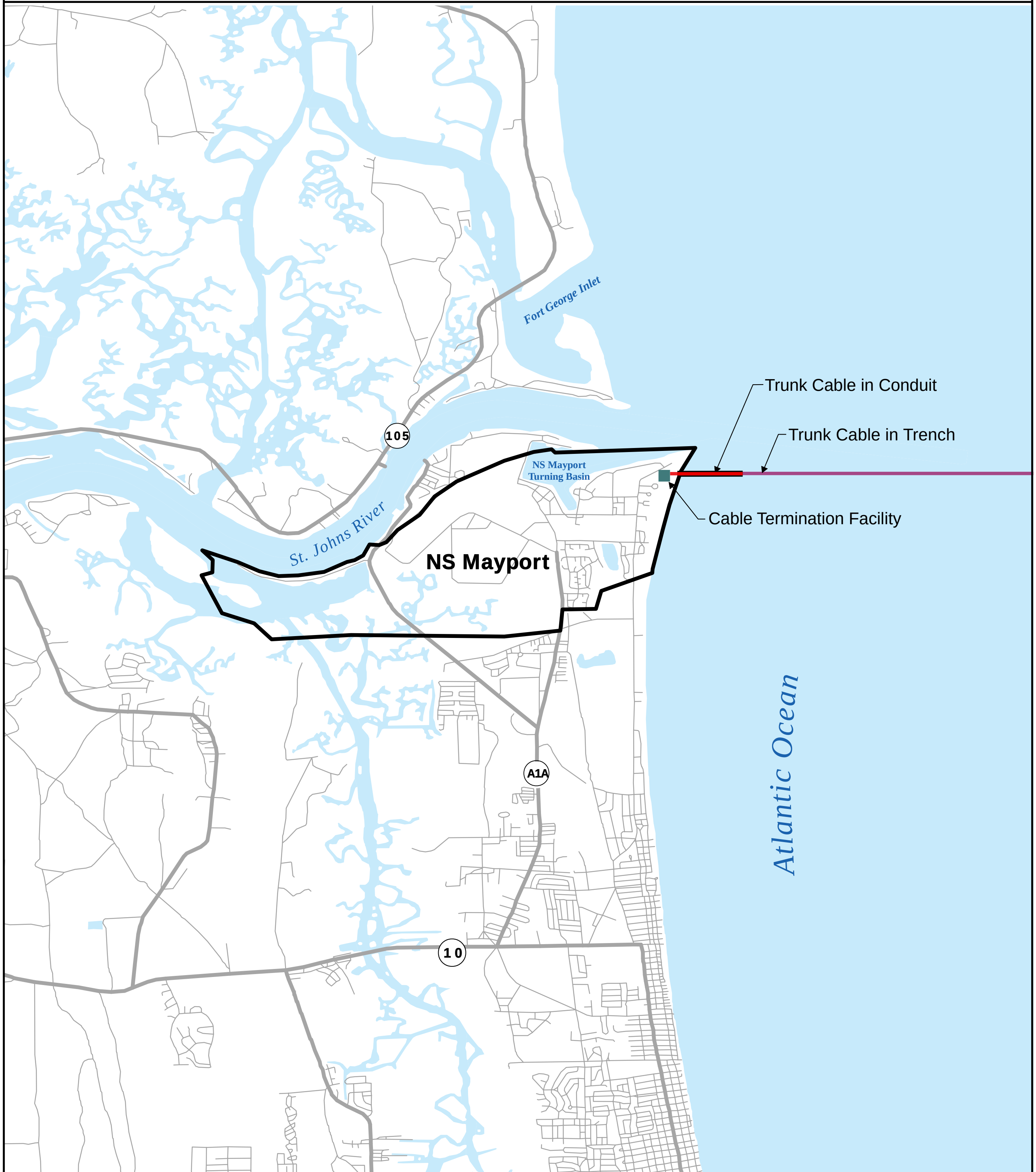


Figure 2-12

Site A Cable Installation Location



NS Mayport
Road
Building

2 0 2 Kilometers
1 0 1 Miles
N

Source: USGS 100K Jacksonville East Quad, 1977.

Figure 2-13

Site A Landside Cable Installation, NS Mayport, Florida

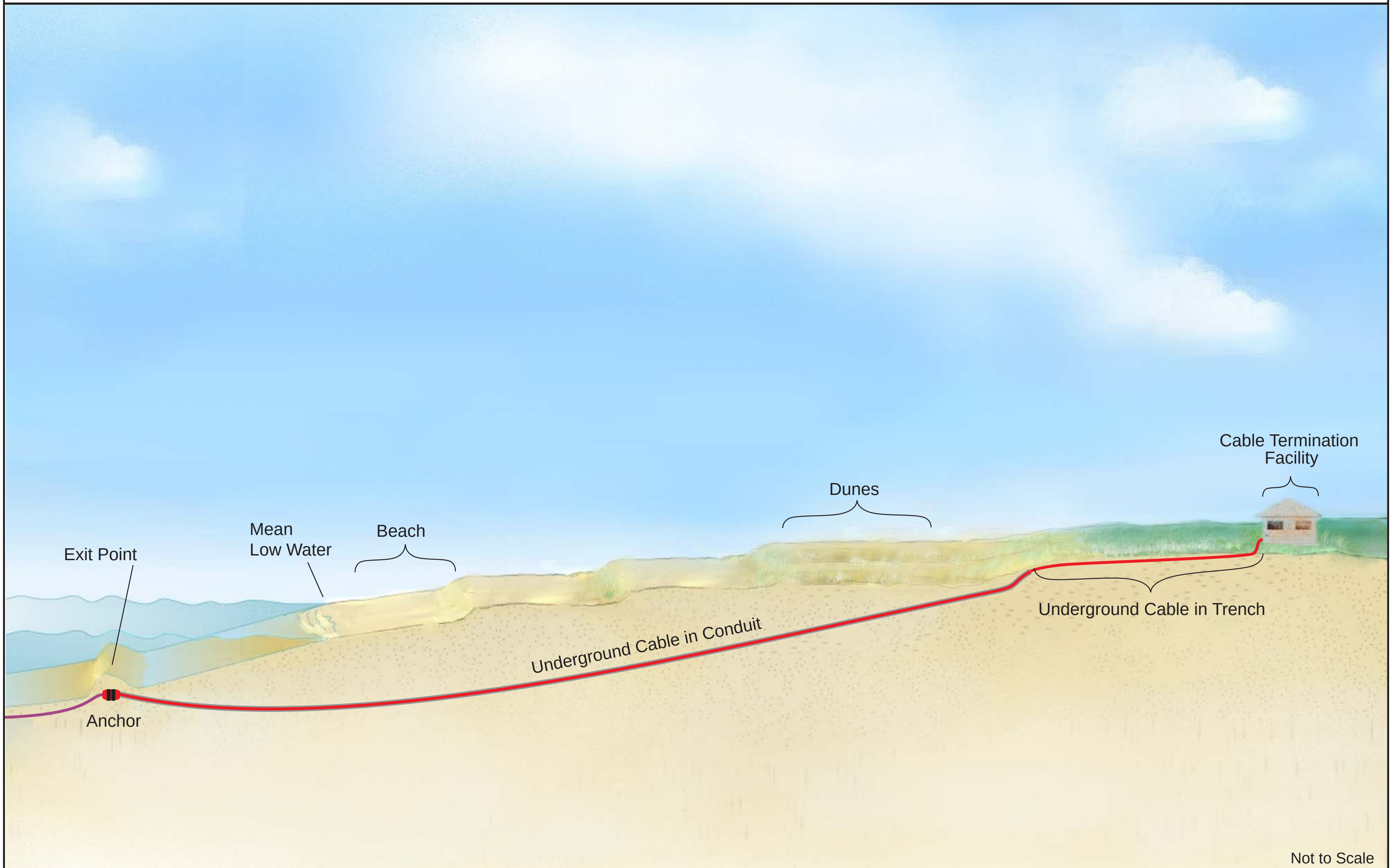
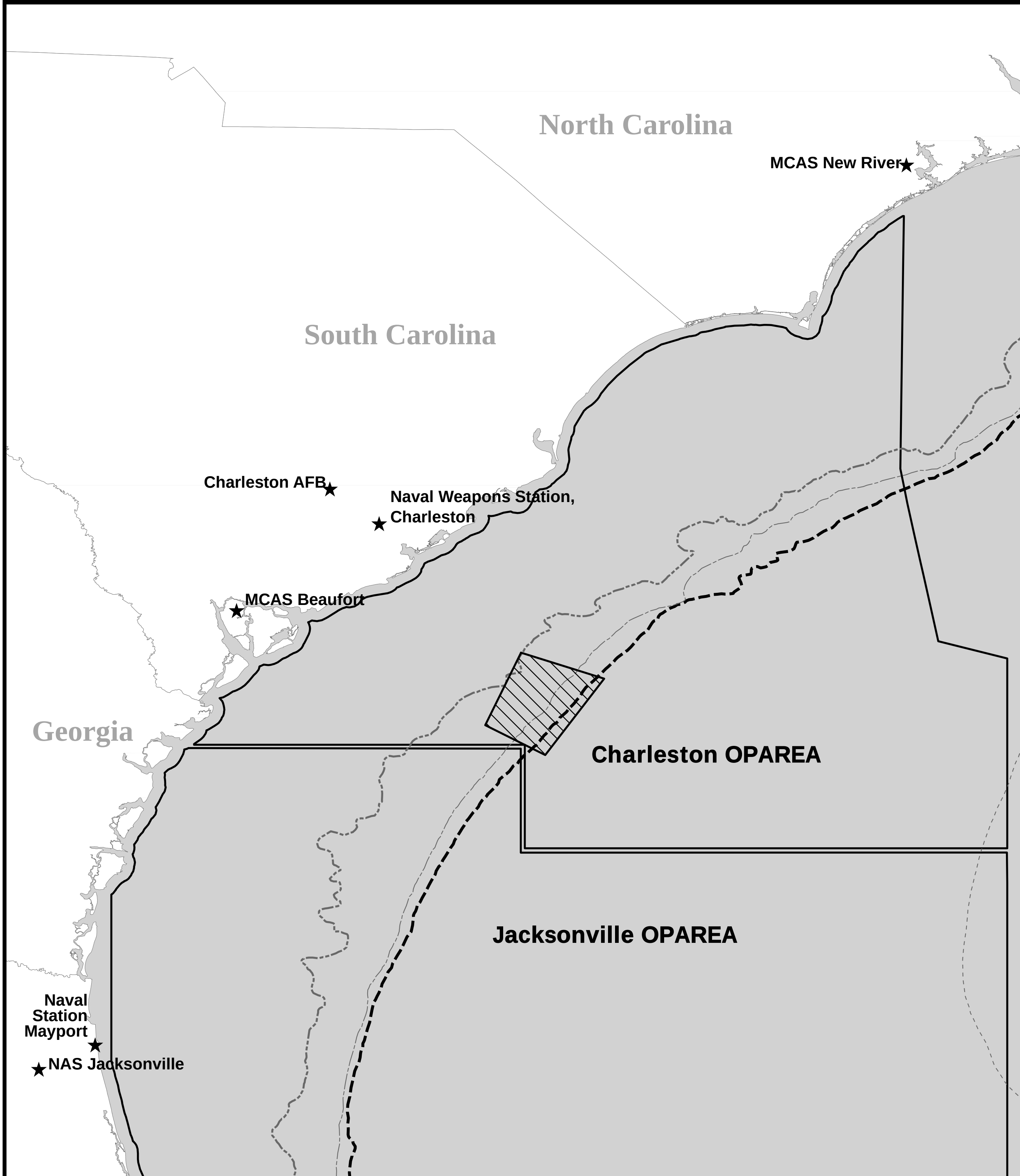


Figure 2-14

Site B Range Within the Charleston 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)

Site B USWTR
OPAREA
Continental Shelf Break

50 0 50 Kilometers
25 0 25 Nautical Miles
N

Source: SEAMAP, 2001.

Figure 2-15

Site B Range Concept

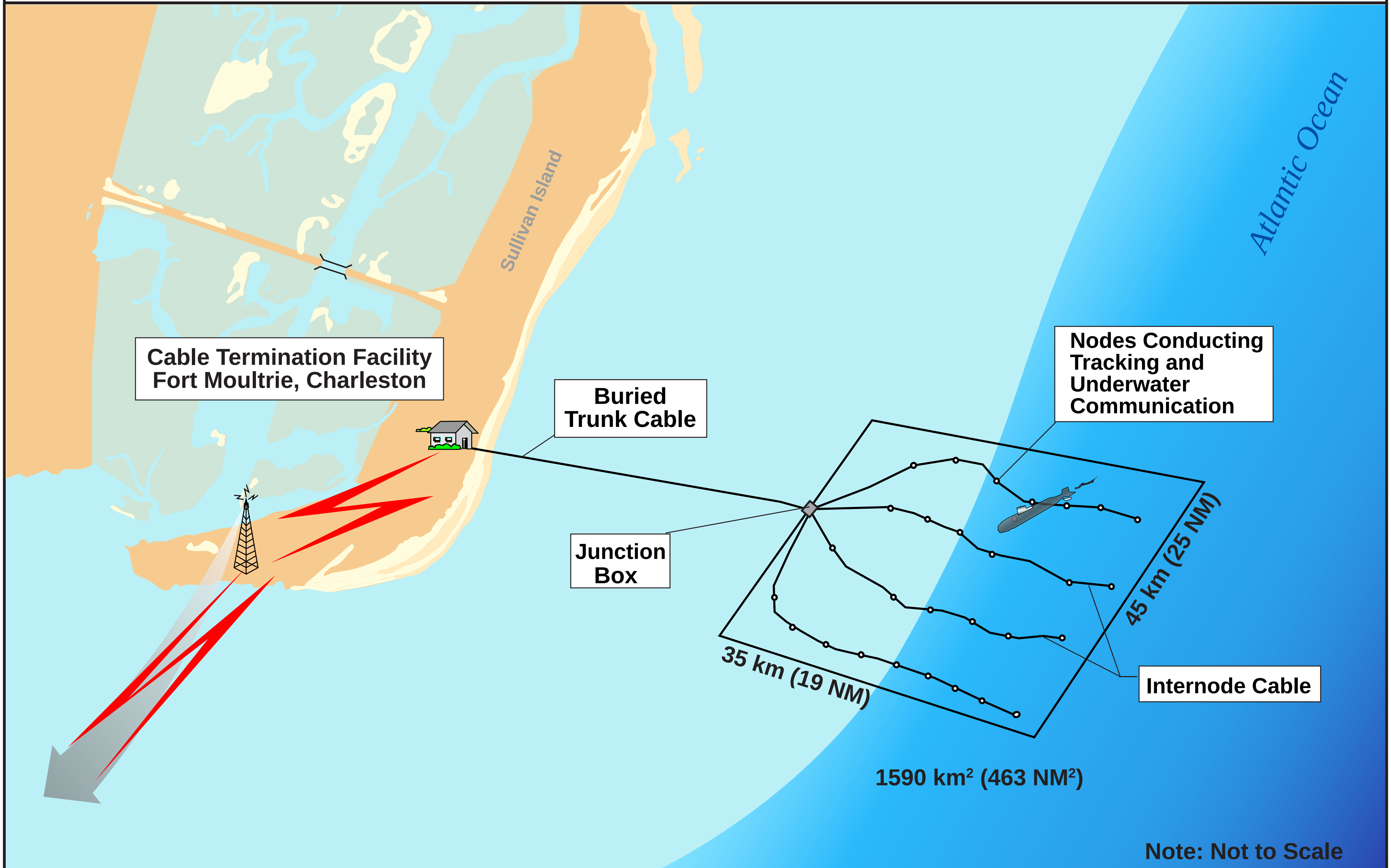


Figure 2-16

Site B Cable Installation Location

Figure 2-17

Site B Landside Cable Installation, Ft. Moultrie, South Carolina

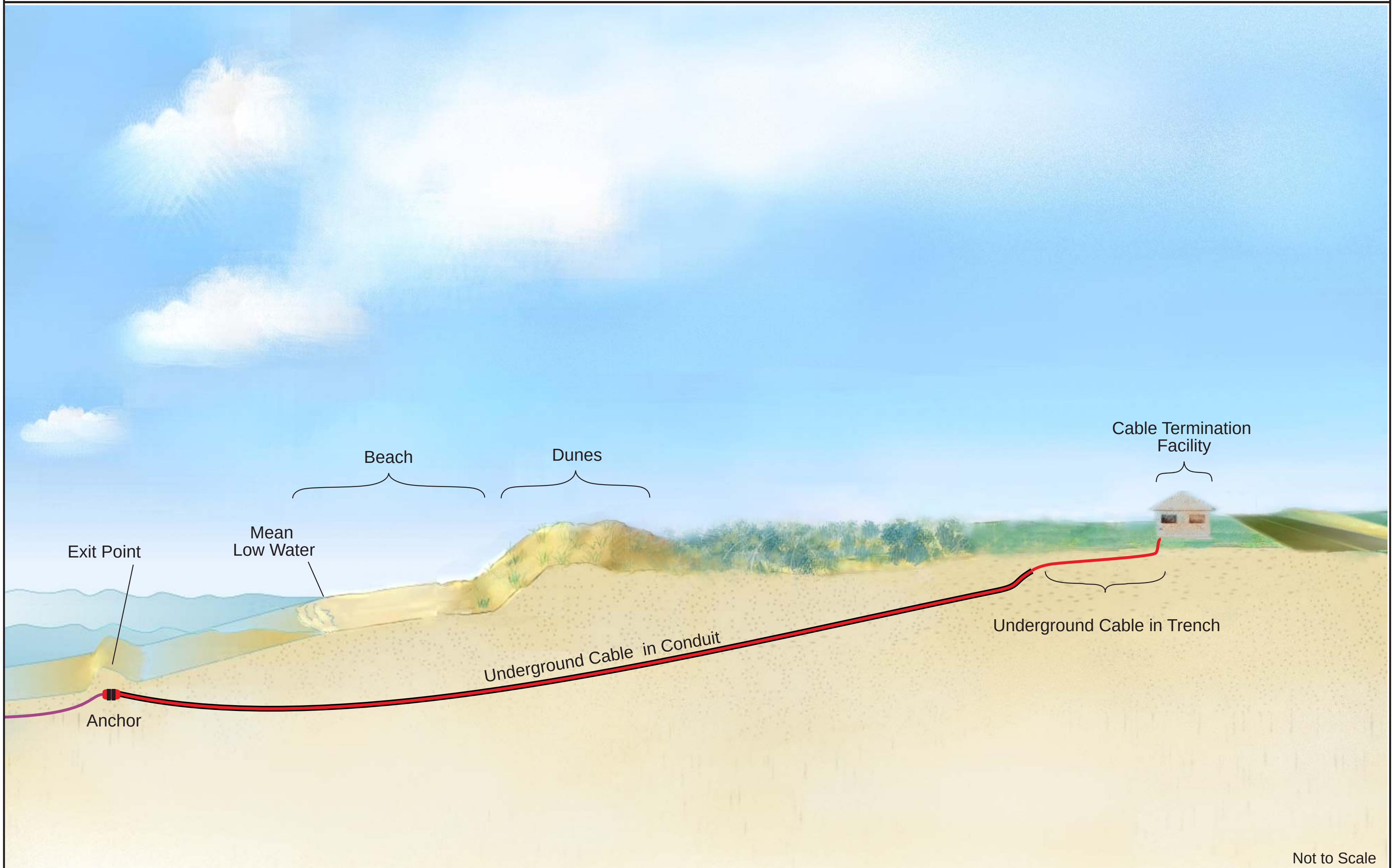
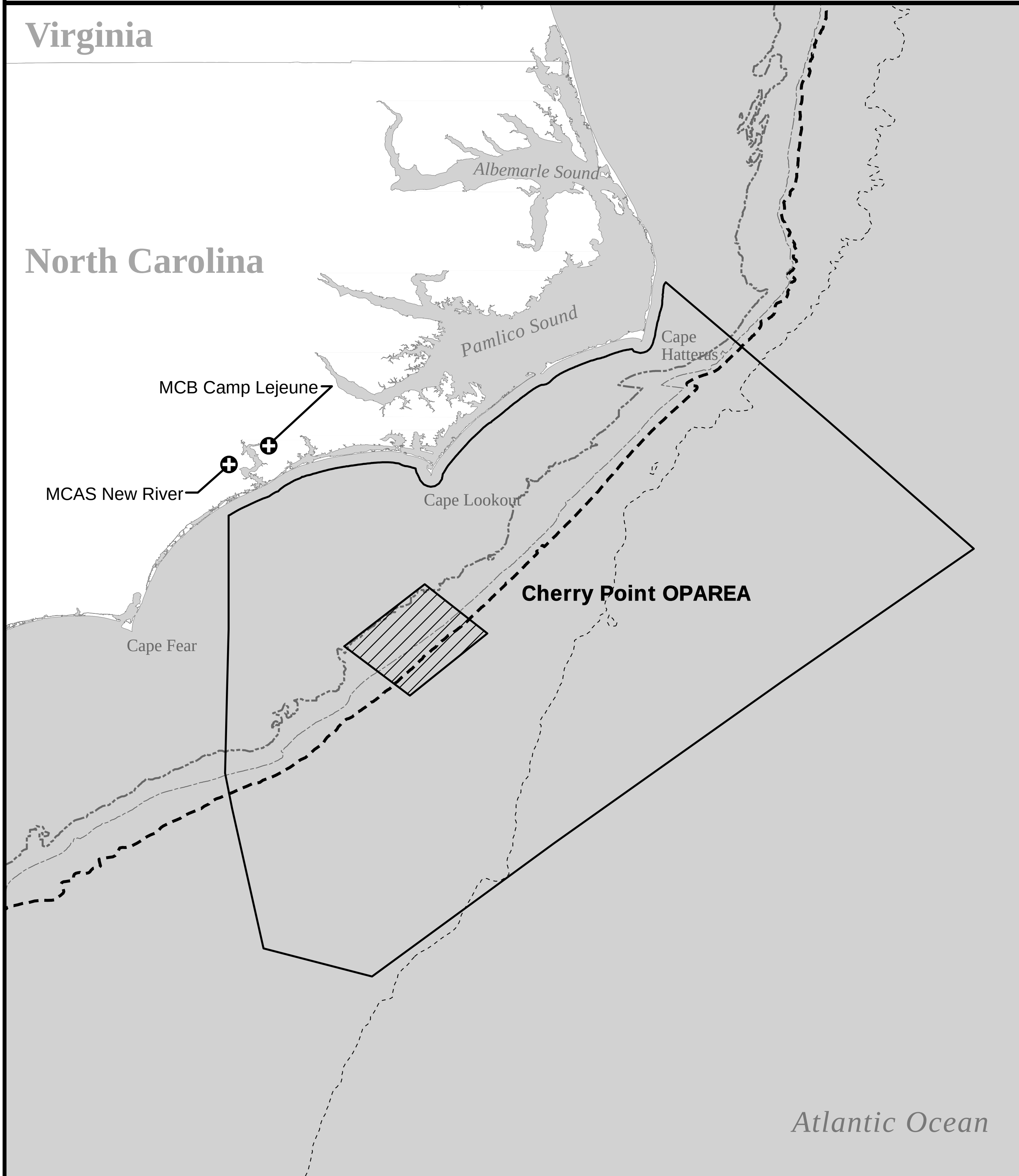


Figure 2-18

Site C Range Within the Cherry Point 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)

Source: SEAMAP, 2001.

Site C USWTR

Cherry Point OPAREA

Continental Shelf Break

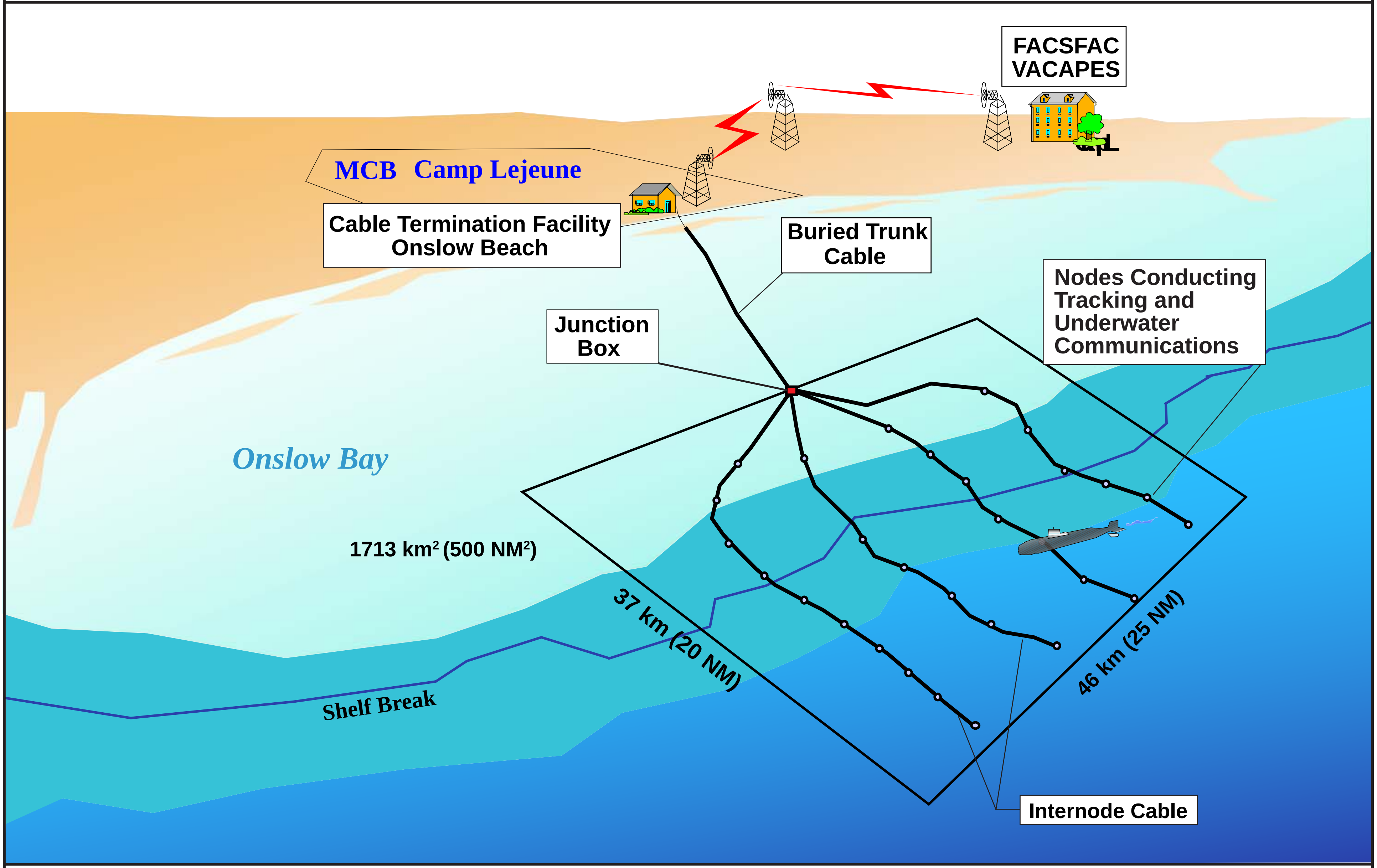
40 0 80 Kilometers

20 0 40 Nautical Miles

N

Figure 2-19

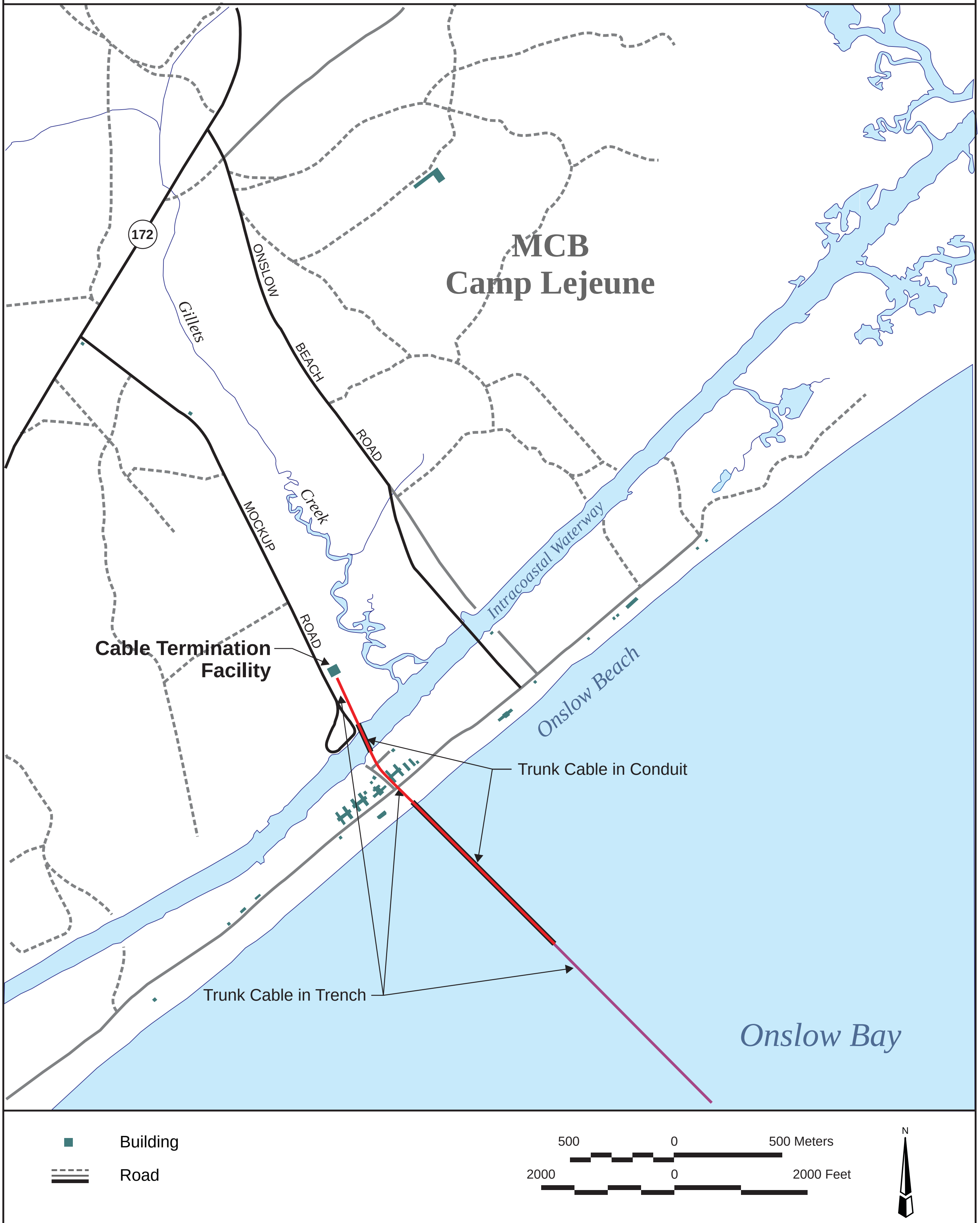
Site C Range Concept



Not to Scale

Figure 2-20

Site C Cable Installation Location



Source: USGS.

Figure 2-21

Site C Landside Cable Installation, Onslow Beach, North Carolina

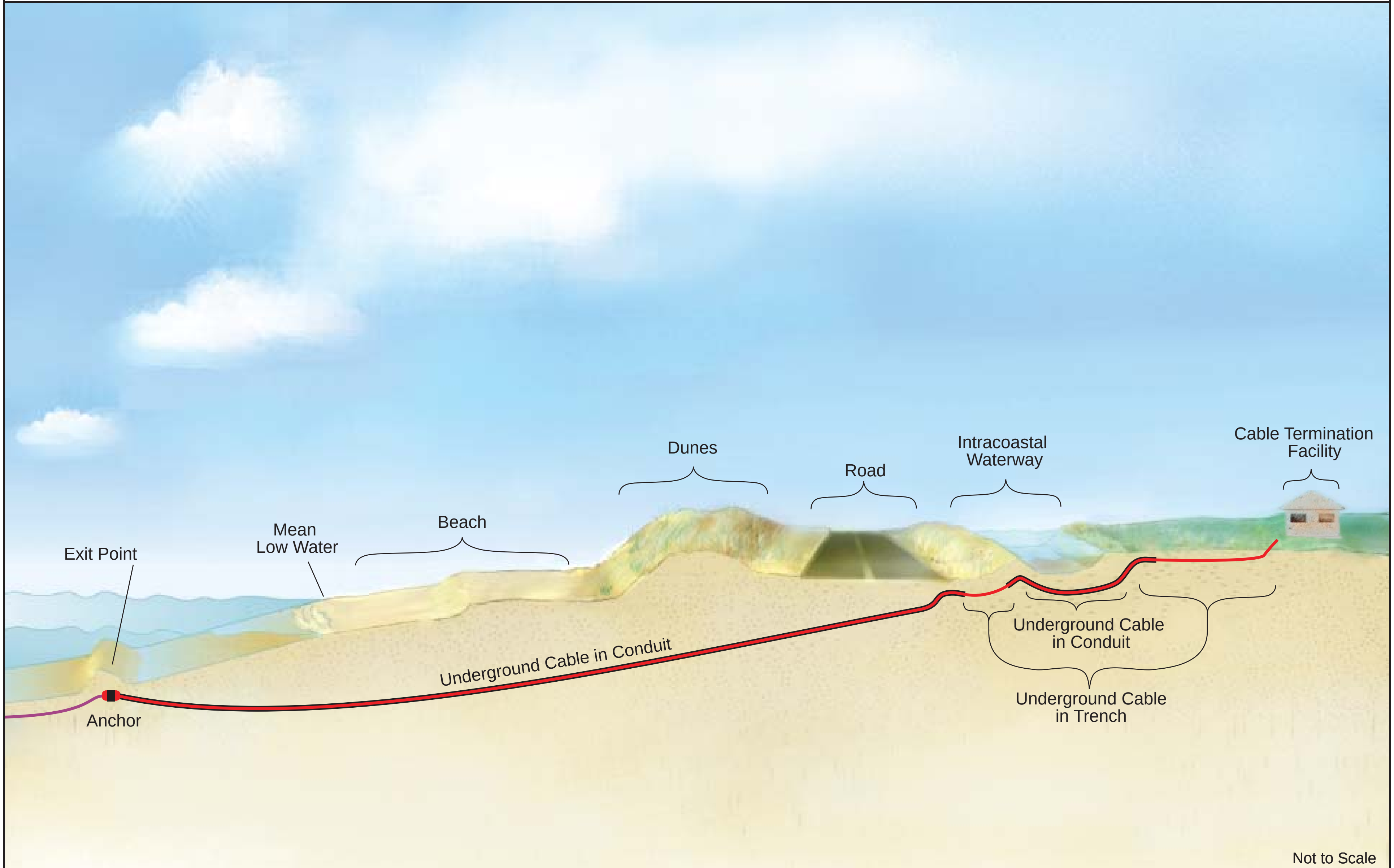
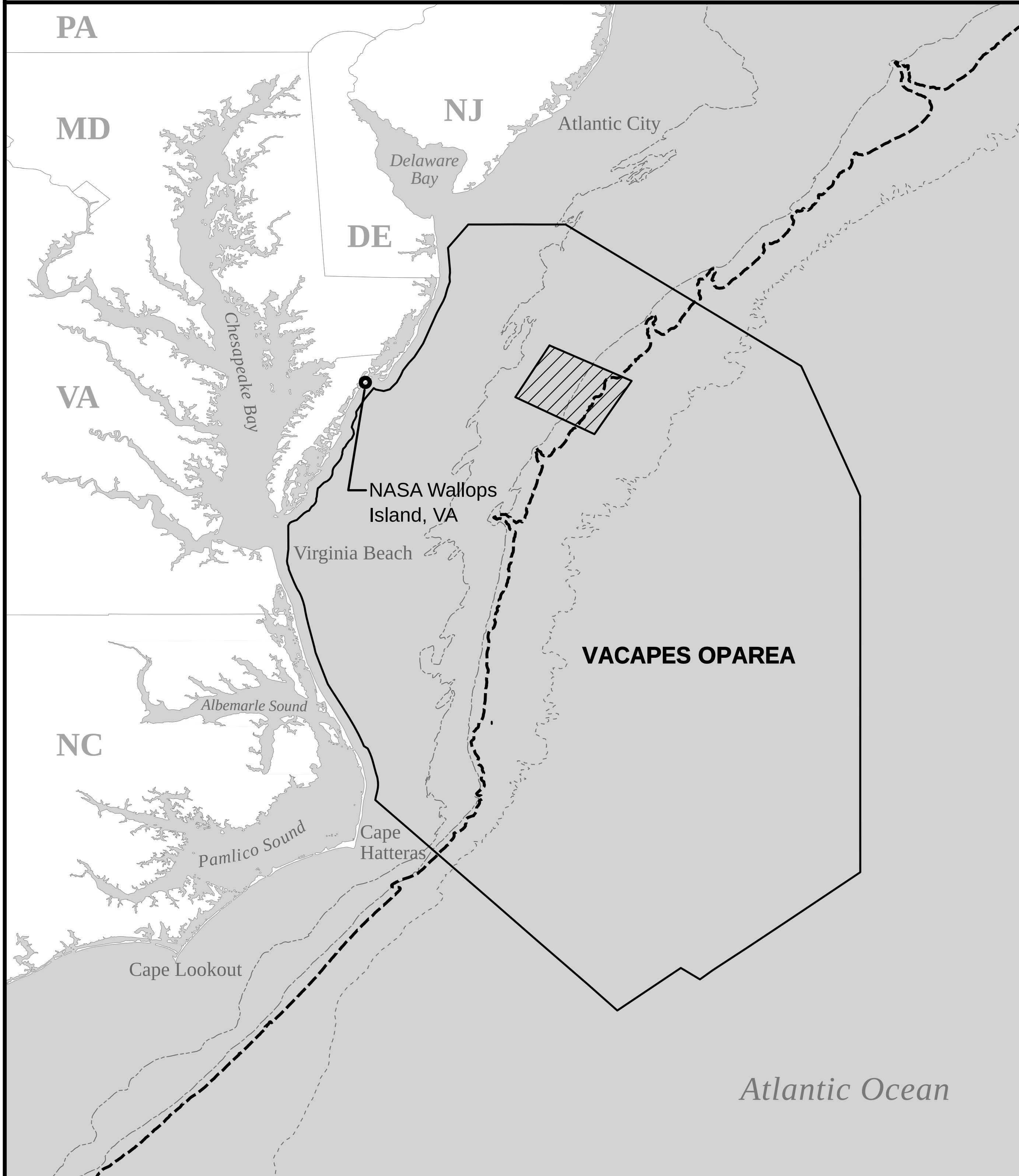


Figure 2-22

Site D Range Within the VACAPES 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)

Source: SEAMAP, 2001.

- NASA Wallops Island
- Site D Range
- VACAPES OPAREA
- Continental Shelf Break

40 0 80 Kilometers

20 0 40 Nautical Miles

N

Figure 2-23

Site D Range Concept

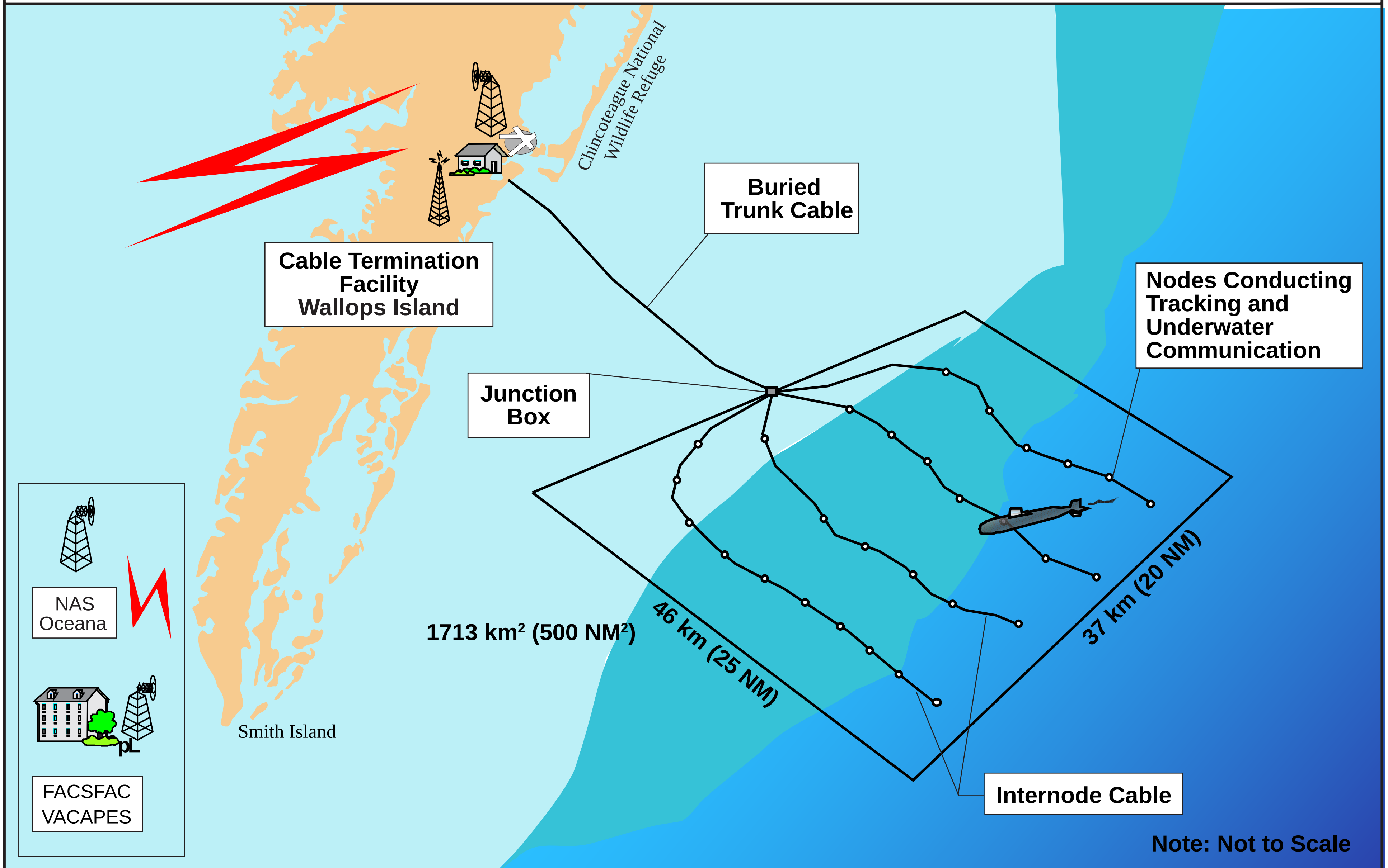


Figure 2-24

Site D Cable Installation Location

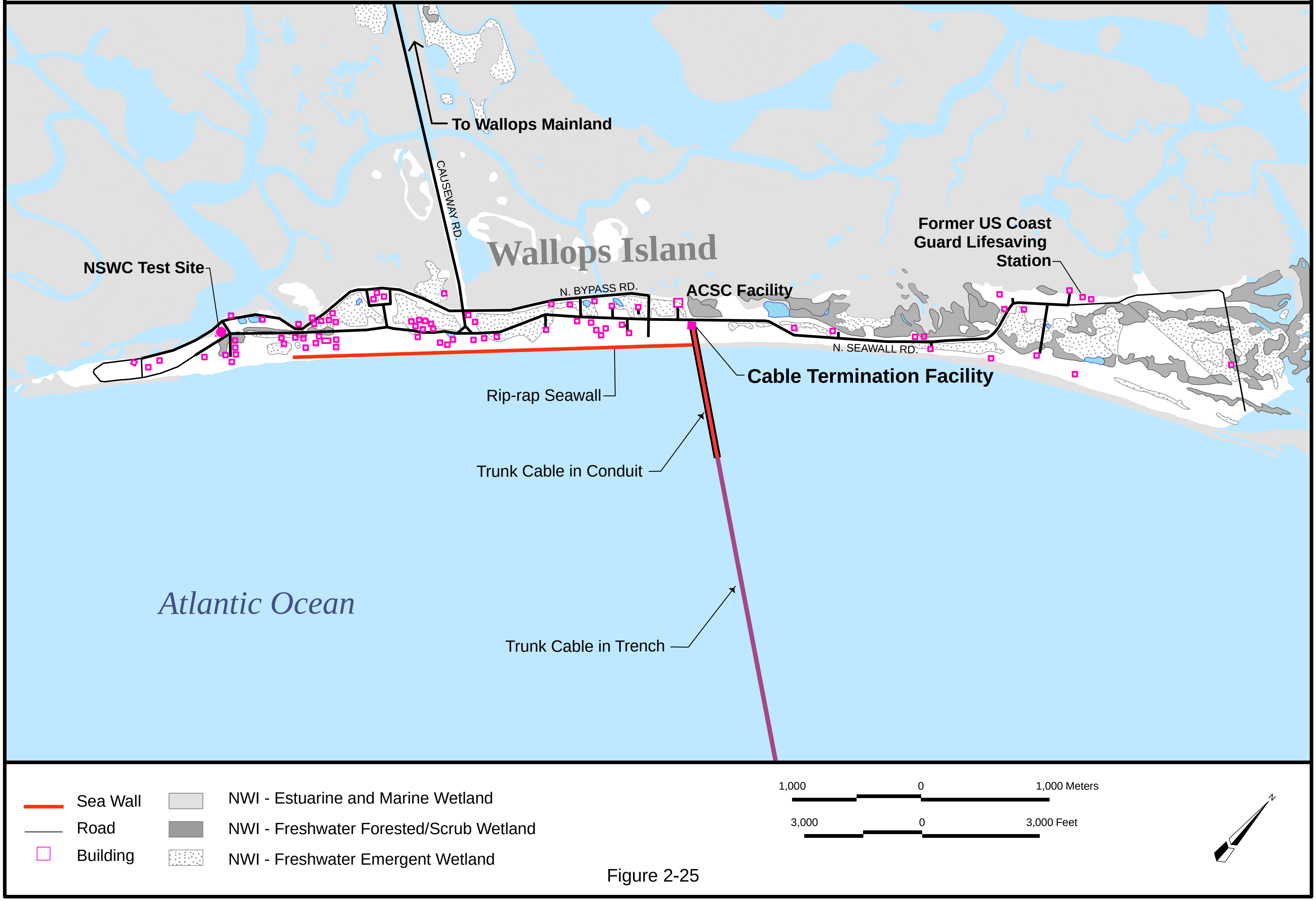


Figure 2-25

connected to underground cable in a trench which would be connected in conduit to bury and protect the cable through the surf zone and under the existing seawall (Figure 2-26).

Commercial power and telecommunications connections would be made to the NASA WFF infrastructure.

2.5.5 No Action Alternative

CEQ regulations provide that a No Action Alternative should be included in the analysis of alternatives and associated impacts. 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, no USWTR would be installed off the east coast of the U.S. However, under the No Action Alternative, ASW training, including active sonar activities, would continue across Navy OPAREAs and adjacent areas in a manner that maximizes training and RDT&E opportunities. A detailed analysis of current ASW training impacts is contained in the Navy’s Atlantic Fleet Active Sonar Training Final Environmental Impact Statement/Overseas Environmental Impact Statement (DoN, 2008h).

Although a No Action Alternative would not prevent the Navy from maintaining ASW readiness, the No Action Alternative would be detrimental to training efficiency and effectiveness primarily because it lacks timely feedback of performance data to participating units.

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Site D Landside Cable Installation, Wallops Island, Virginia

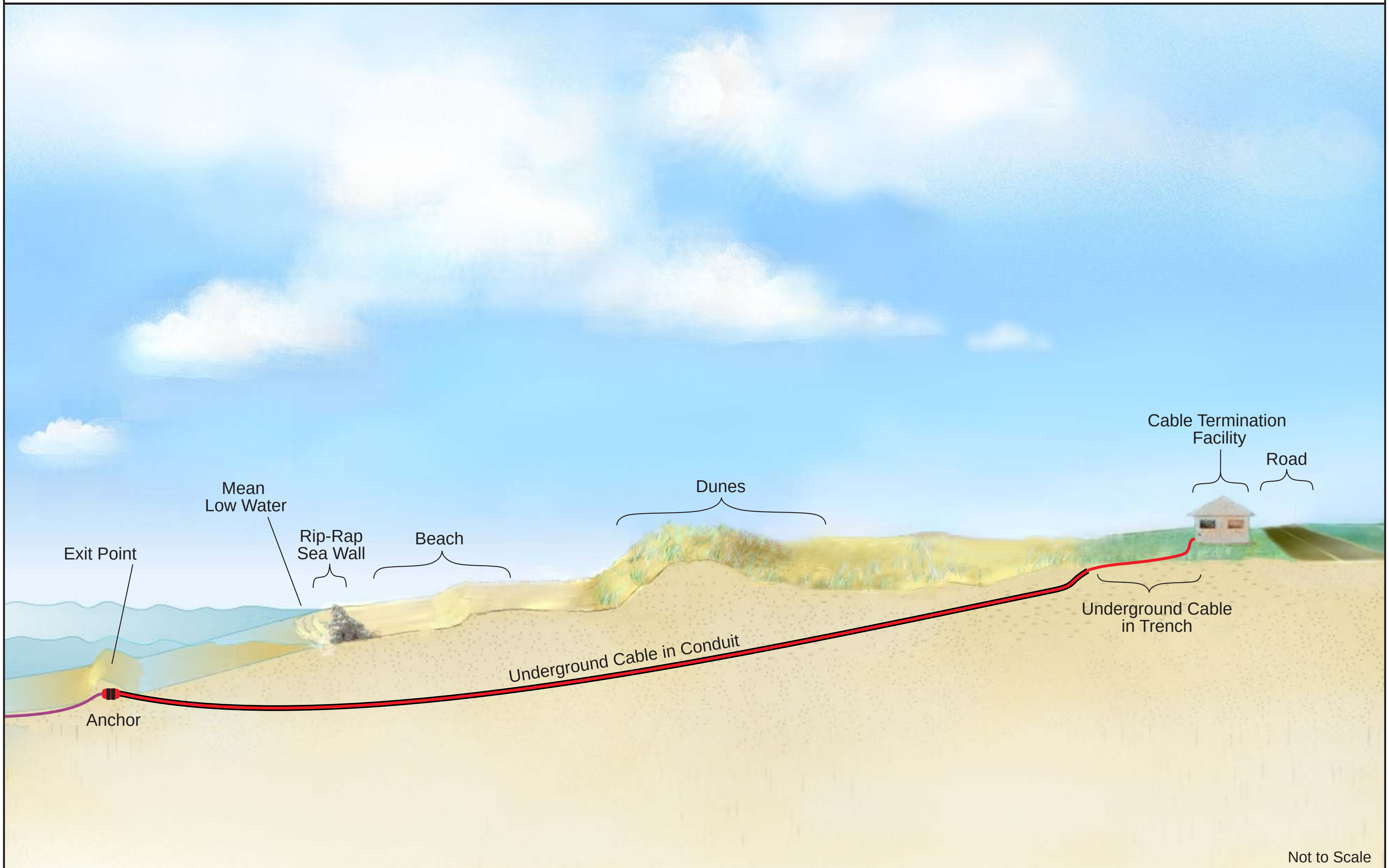


Figure 2-26

3 AFFECTED ENVIRONMENT

The Navy is meeting its EO 12114 responsibilities by preparing the OEIS, which includes a review of the affected environment and a description of any adverse environmental impacts that cannot be avoided if the proposed action is adopted. The Navy is meeting its NEPA requirements through the EIS. The CEQ's regulations implementing NEPA (40 CFR Part 1500) require that an EIS succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration, and that impacts be discussed in proportion to their significance.

Consequently, this chapter presents a discussion of several affected environments that could be impacted by implementation of the proposed USWTR, as follows:

- Physical characteristics of the marine environment, including geology, bathymetry, substrate, water, and currents (Subchapter 3.1)
- Ecological systems, including marine animals and their habitats and threatened and endangered species (Subchapter 3.2)
- The underwater acoustical environment, including background information on acoustical terminology and the hearing characteristics of marine animals (Subchapter 3.3)
- Socioeconomic conditions, including data on commercial and recreational fishing (Subchapter 3.4)
- Cultural resources at sea including shipwrecks (Subchapter 3.5)
- Landside environment including the proposed location for the USWTR cabling (Subchapter 3.6)
- Coastal resources uses and the relationship of the CZMA to the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREA sites (Subchapter 3.7)

The analysis of these affected environments will present a baseline against which the impacts of implementation of the USWTR can be measured.

As described in Chapter 2, the proposed USWTR Sites A, B, C, and D occupy a small portion of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs, respectively. The affected environment is described in this chapter with respect to these OPAREAs.

The majority of the information presented here was compiled from the Navy's Marine Resource Assessments (MRA) program. The Navy MRA program is implemented by the U.S. Navy

Commander, Fleet Forces Command, to collect data and information concerning the protected and commercial marine resources found in the Navy's OPAREAs. Specifically, the goal of the MRA program is to describe and document the marine resources present in each of the Navy's OPAREAs. Significant effort has been made to ensure that all applicable data sources have been considered and included in the assessment of protected species distributions.

The MRAs represent a compilation and synthesis of available survey data (primarily NMFS surveys), stranding, incidental fisheries bycatch, tagging, satellite tracking, and nesting data, as well as peer-reviewed literature and NMFS reports, including stock assessment reports, recovery plans, and survey reports.

The Internet and collaboration with other agencies and institutions were additional sources of information used to compile this final OEIS/EIS, as referenced within the text.

3.1 Physical Environment

Operational requirements for the USWTR require a depth of 37 to 274 m (120 to 900 ft), a depth that generally falls within the areas of the continental shelf and the continental slope. The continental shelf is a broad, shallow, sea-floor platform that, although submerged, is clearly part of the continental mass. Along the Atlantic Coast, the continental shelf extends from the shoreline to a depth of about 200 m (660 ft). At the shelf edge, the shelf gives way sharply to the continental slope, which descends about 3,500 m (12,000 ft) to the main ocean floor. The gradient of the continental shelf is generally flat, with a regional slope of 1 m per km (0.01%), while the continental slope is much steeper.

The proposed USWTR Sites A, B, C, and D under consideration are located on the outer continental shelf, offshore of the coastal plain in the eastern United States. The continental shelf ranges from a maximum width of more than 300 km (162 NM) off New Jersey to a minimum width of less than 50 km (27 NM) off Cape Hatteras, North Carolina, with an average width of 65 km (35 NM).

3.1.1 Geology, Bathymetry, and Substrate

The surface of the continental shelf is uneven, with small hills and ridges alternating with basin-like depressions, broad valley-like troughs, and occasional narrow steep-walled valleys called submarine canyons. Most areas of the continental shelf were above sea level during the last glaciation (two million to ten thousand years ago), and were subject to the erosion and sedimentation. The majority of the material on the continental shelf and slope comes from the land, transported by rivers or wind. Waves and tidal currents acting on the shelves have modified the surface since the last glaciation. Coarse material such as sand tends to deposit in shallow waters while silt and mud particles are carried into deeper water for deposition.

Geological oceanographic considerations that may affect the final design, installation, and operation of the USWTR include bottom composition (as it affects the ability to bury a submarine cable); bottom hardness (as it affects the reflection of sound from the seabed); and sediment transport (as it may bury a hydrophone or expose a buried submarine cable) (DeAlteris, 1996).

3.1.1.1 Site A

The proposed Site A USWTR is located offshore of northeast Florida in the South Atlantic bight (SAB). The edge of the range would be approximately 94 km (51 NM) from shore. The depth of water at the proposed site ranges from 37 to 366 m (120 to 1,200 ft). Figure 3.1-1 depicts the bathymetry of the area which shows ocean floor depth and relief/terrain as contour lines (called depth contours or isobaths).

The physiography of the sea floor beneath the Jacksonville OPAREA is notably featureless. The wide, flat Florida-Hatteras Shelf, underlying about half of the OPAREA, is characterized by low relief and a relatively gentle gradient. The remainder of the sea floor beneath the OPAREA consists of the northern two-thirds of Blake Plateau, a massive physiographic feature that measures 228,000 km^2 (71,250 NM^2) in size. The proposed USWTR site is situated on the slope between the continental shelf and the Blake Plateau.

This entire area has been eroded and shaped by the Gulf Stream, giving it a unique continental margin. The sea floor has relatively smooth topography and is composed primarily of fine sand and gravel with a high concentration of carbonate shells.

The Southeast Area Monitoring and Assessment Program (SEAMAP) (Atlantic States Marine Fisheries Commission [ASMFC], 2001) database contains data for 115 of the 597 grid cells in the proposed Site A USWTR. Of these cells, 46% (53) were classified as hard bottom[1], 10% (11) were classified as possible hard bottom, and 44% (51) were classified as not hard bottom.

3.1.1.2 Site B

The proposed Site B USWTR would be located offshore of northeastern South Carolina in the SAB. The edge of the range would be approximately 83 km (45 NM) from shore. The depth of water at the proposed site ranges from 37 to 305 m (120 to 1,000 ft). Figure 3.1-2 depicts the bathymetry of the area which shows ocean floor depth and relief/terrain as contour lines (called depth contours or isobaths).

[1] Hard bottom is defined as an area of the sea floor, usually on the continental shelf, associated with hard substrate such as rocks, boulders, or outcroppings of hard rock that may serve as attachment surfaces for organisms such as corals, sponges, or other benthic invertebrates or algae (SAFMC, 1998a). See Subchapter 3.2.4 for details.

The Charleston Bump is a distinctive feature of the sea floor in the Charleston OPAREA, consisting of a rocky island of bottom relief located at approximately 31°30'N and 79°W in 400 to 700 m (1,312 to 2,297 ft) water depth (Bane et al, 2001). The bump includes an underwater ridge and trough complex that runs roughly perpendicular to shore and to the Gulf Stream flow. This “island” of relief in an otherwise flat seafloor bottom causes an offshore deflection of the Gulf Stream’s path and the occurrence of meanders, eddies, and upwelling over the continental shelf in this area. The Charleston Bump provides a unique habitat area for pelagic and demersal fishes.

The distribution of bottom sediments found on the continental shelf and slope of the SAB are more complex than those found in other areas (Amato, 1994). The layers of sand and gravel are much thinner than found north of Cape Hatteras, and rock outcrops are common. Most of the sediments found covering the continental shelf of the SAB are quartzose sand with a thin band of fine-grained sand and silt. The bottom sediments found south of Cape Hatteras contain from 5 to 50% calcium carbonate.

The SEAMAP (ASMFC, 2001) database contains data for 48 of the 562 grid cells in the proposed Site B USWTR. Of these cells, 54% (26) were classified as hard bottom, 10% (5) were classified as possible hard bottom, and 36% (17) were classified as not hard bottom.

3.1.1.3 Site C

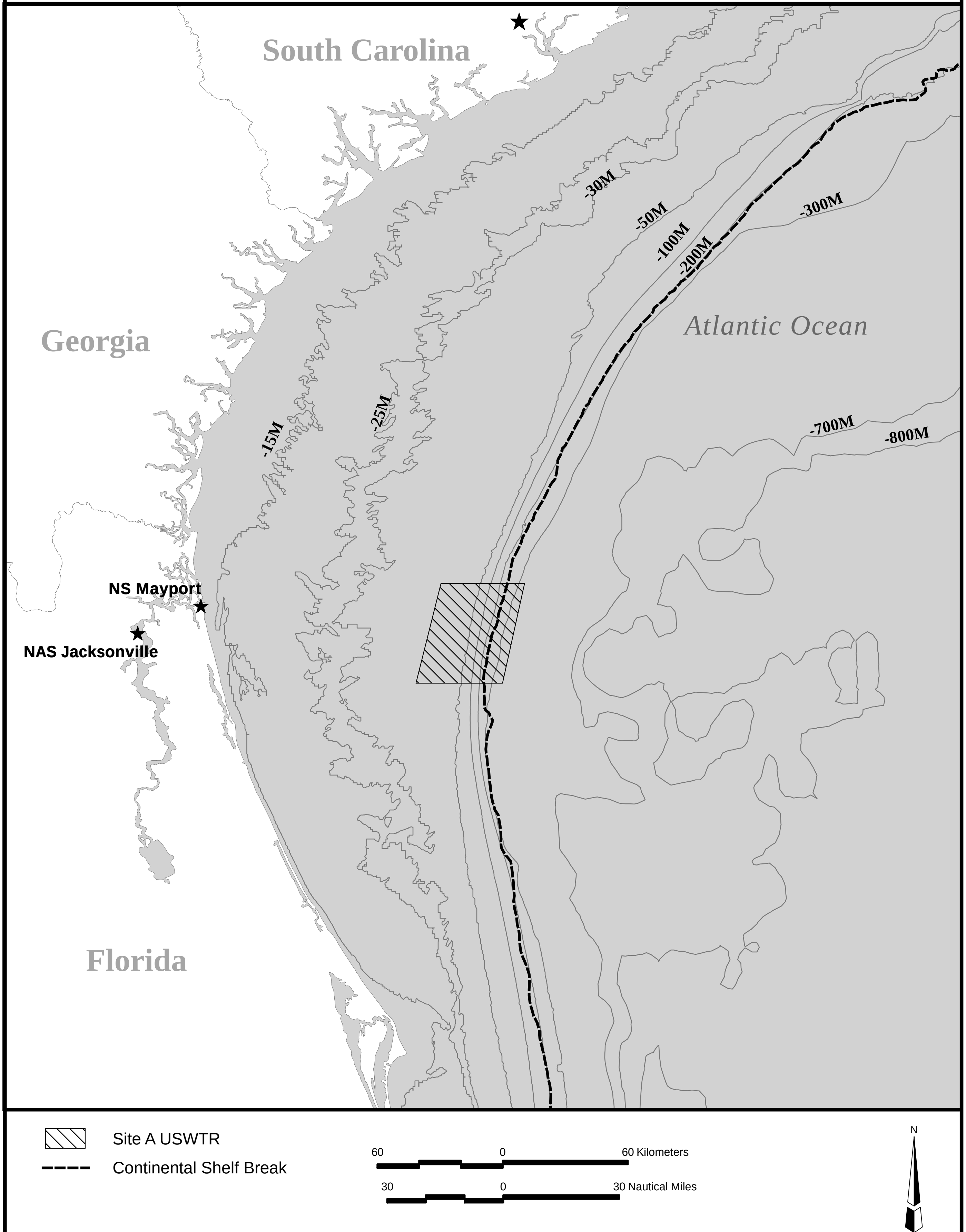
The proposed Site C USWTR would be located offshore of northeastern North Carolina in Onslow Bay. The site is in the Cherry Point OPAREA in the South Atlantic bight (SAB). The edge of the range would be approximately 86 km (47 NM) from shore.

Onslow Bay lies between Cape Lookout and Cape Fear, North Carolina. It is located in the northern portion of the Florida-Hatteras shelf region. New River drains a small portion of the central North Carolina Coastal Plain Province and discharges into the center of Onslow Bay. Figure 3.1-3 depicts the bathymetry of the area around the proposed Site C USWTR.

The continental shelf off North Carolina is relatively narrow, but is morphologically complex as compared to other areas of the continental shelf (DeAlteris, 1996). A long, linear trough (Carolina trough) underlies most of the continental shelf and slope in this region. Sediments on the outer shelf and upper slope lie in a series of lenses caused by repeated erosion and deposition on the outer shelf by the Gulf Stream. The upper-slope morphology is further complicated by the occasional buildup of carbonate reefs just seaward of the shelf break. The most abundant rocks are sandstone and limestone with a high percentage of fossils.

The slope extends from 100 to 400 m (328 to 1,312 ft) within the limits of the study area. Side-scan sonar shows areas of rough hard bottom, areas of smooth sand bottom, and areas with alternating hard and soft bottom. The shallower portion of the slope is characterized by smooth sand, while the deeper portion is characterized by large-scale sand waves (DeAlteris, 1996). Sub-

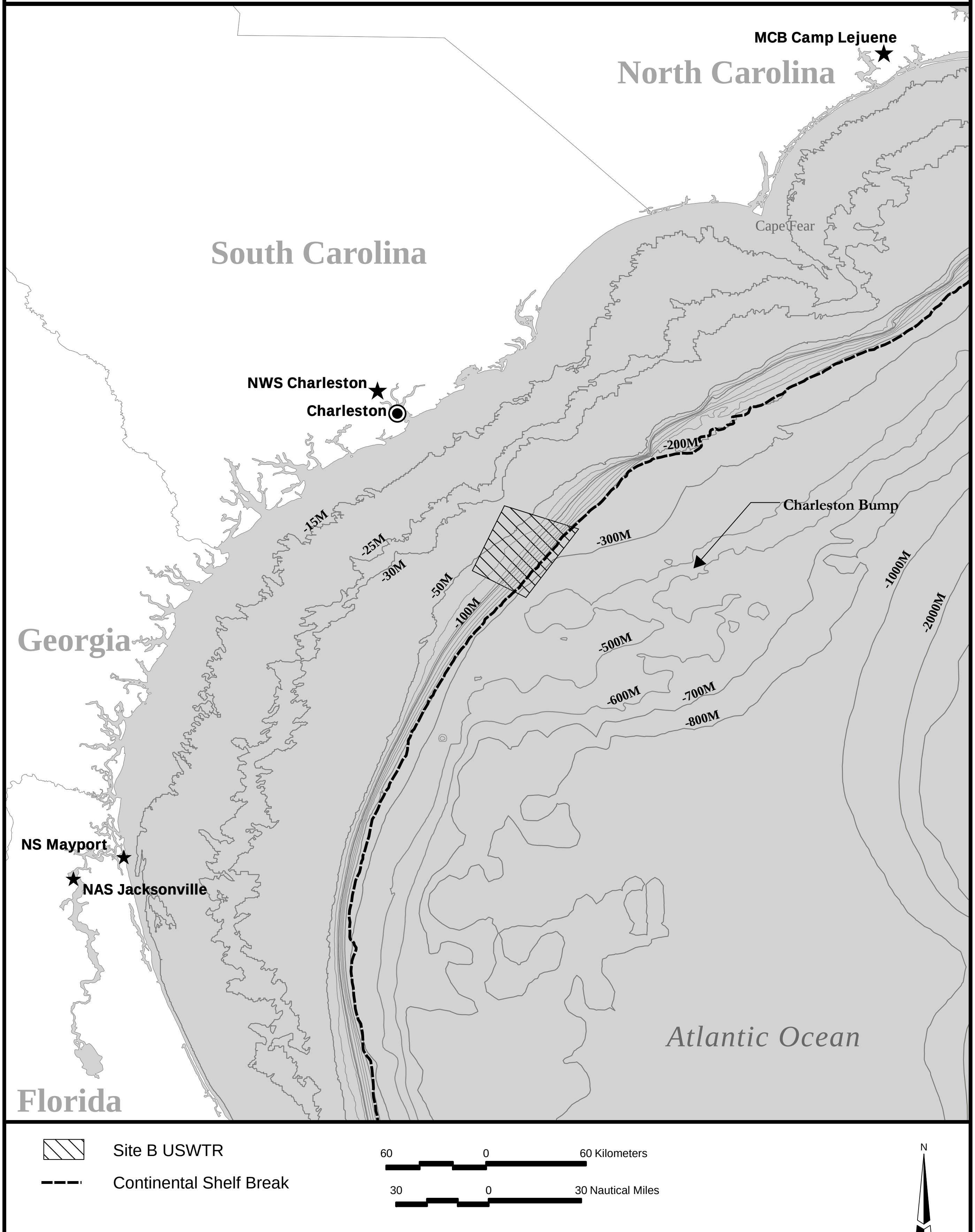
Bathymetry in the Site A Area



Note: Map data not projected.

Figure 3.1-1

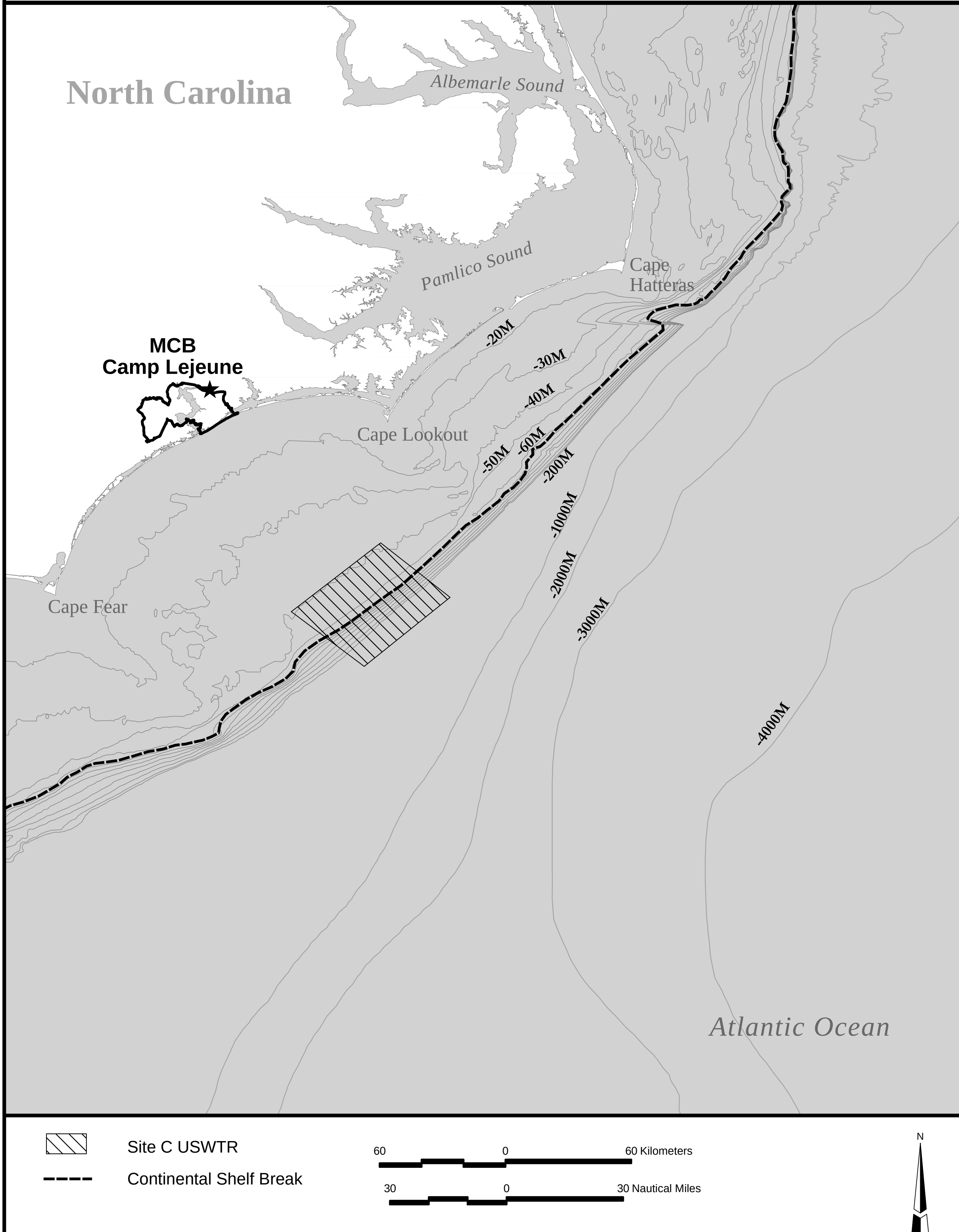
Bathymetry in the Site B Area



Note: Map data not projected.

Figure 3.1-2

Bathymetry in the Site C Area



Note: Map data not projected.

Figure 3.1-3

bottom echo sounder data show areas of hard and soft bottom. The sampling showed no large bottom obstructions in the area.

The SEAMAP (ASMFC, 2001) database contains data for 143 of the 687 grid cells in the proposed Site C USWTR. Of these cells, 31% (44) were classified as hard bottom, 12% (17) were classified as possible hard bottom, and 57% (82) were classified as not hard bottom. Moser et al. (1995) found evidence of hard bottom at 11% of the 5,796 stations evaluated, with 5% of the stations classified as possible hard bottom.

3.1.1.4 Site D

The proposed Site D USWTR would be located offshore of northeastern Virginia within the Mid-Atlantic bight (MAB). The edge of the range would be approximately 85 km (46 NM) from shore.

The depth of water in the continental shelf at the proposed Site D USWTR averages 75 m (246 ft) (DoN, 1995b). From the geographic center of the site, the 40-m (131-ft) contour extends 37 km (20 NM) landward, and the 400-m (1,312-ft) contour extends 18 km (10 NM) seaward. The shelf edge occurs at 200 m (656 ft). Figure 3.1-4 depicts the bathymetry of the area around the proposed Site D USWTR.

Sediment texture varies from gravel patches and a fine sand mixture inshore to medium sand offshore, extending to the shelf edge. Fine sand/silt characterizes the edge of the shelf from 200 to 400 m (656 to 1,312 ft). The sediments at the proposed Site D USWTR are typical of the offshore-to-shelf-edge area, consisting of fine quartz sand with a patchy veneer of shells (DoN, 1995b). No hard bottom data are available for the proposed Site D location, as it is outside the area covered by SEAMAP data.

3.1.2 Water Characteristics and Currents

This subchapter describes the general water characteristics and circulation patterns of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs. The Gulf Stream has a pronounced influence on the four OPAREAs. The western continental margin of any ocean basin is the location of intense boundary currents; the Gulf Stream is the western boundary current of the North Atlantic Ocean. The Gulf Stream is part of a larger current system called the Gulf Stream System that also includes the Loop Current in the Gulf of Mexico and the Florida Current in the Atlantic, between the Straits of Florida and Cape Hatteras.

The Gulf Stream is a powerful surface current, carrying warm water into the cooler North Atlantic, and it exerts a considerable influence on the oceanographic conditions in each OPAREA. In general, the Gulf Stream flows roughly parallel to the coastline from the Florida Straits to Cape Hatteras, where it is deflected from the North American continent and flows northeastward past the Grand Banks. Figure 3.1-5 shows the approximate location of the Gulf

Stream with respect to the proposed USWTR sites. The position of the Gulf Stream as it leaves the coast changes throughout the year. In the fall, it shifts north (landward), while in the winter and early spring it shifts south (seaward). The estimated meridional range of annual variation in stream path is about 100 km (54 NM). Changes in the Gulf Stream's transport, meandering, and structure have been observed at various temporal scales as it flows northeast.

The Gulf Stream usually is sharply defined on its west and north margins as an abrupt boundary or wall, but is less well defined on its east or south margins where the character of the current gradually merges with that of the Sargasso Sea (Pickard and Emery, 1990; Thurman, 1994). Surface velocities range from 3.7 to 9.2 km/hr (2 to 5 kt), and the water temperature is 25 to 28 degrees Celsius (ºC) (77 to 82 degrees Fahrenheit [°F]) (Mann and Lazier, 1991).

The warm, nutrient-poor Gulf Stream waters do not readily mix with the colder, productive polar waters they meet, so a distinct temperature edge is maintained between the Gulf Stream and adjacent waters. As a result, the Gulf Stream forms a tongue of tropical water that extends north and provides habitat for warm-water species in otherwise cold latitudes. Further, sea turtles are known to follow the Gulf Stream up the eastern seaboard on their way to the North Atlantic.

3.1.2.1 Site A

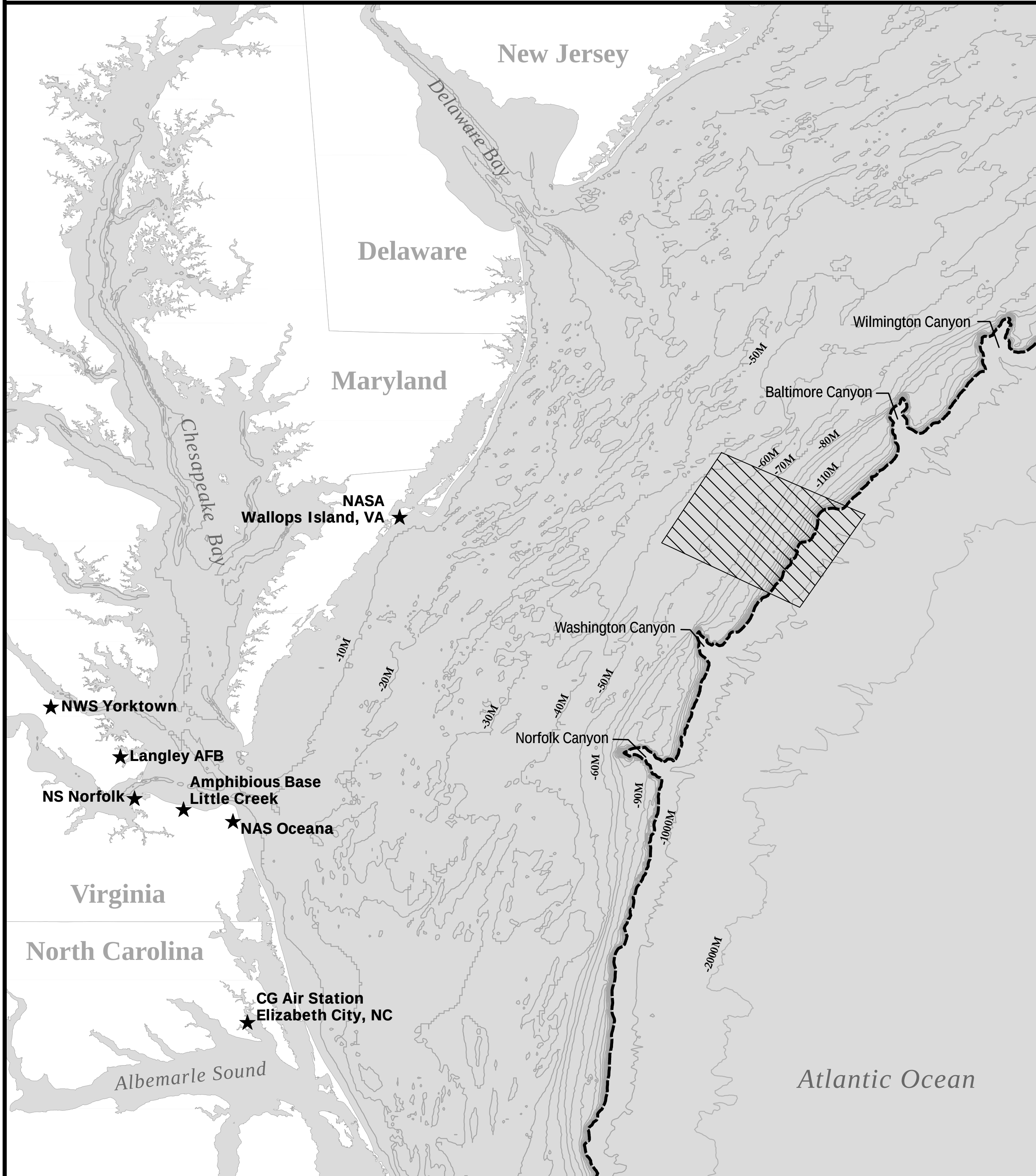
Temperature and Salinity

The waters of the Jacksonville OPAREA follow an annual temperature cycle that lags the seasonal atmospheric temperate changes (DoN, 2008n). Throughout the year, there is an eastern gradient of increasing temperature on the sea surface, with the highest temperature centered in the Gulf Stream. Water temperature and salinity are vertically stratified within the Gulf Stream, with salinity increasing and temperature decreasing with increasing depth. Near the shore, there is a temperature fluctuation greater than 10ºC (18ºF) throughout the year, whereas beyond the shelf break, the annual change in temperature is about half that of shelf waters. The Gulf Stream, which brings warm, tropical waters northward through the offshore region of OPAREA, is largely responsible for maintaining relatively consistent offshore temperatures.

Water temperatures in the Jacksonville OPAREA vary between 19 and 29ºC (66 and 84ºF). The Jacksonville OPAREA has the greatest difference in temperature in the winter, when temperatures vary between 19° and 24ºC (66º and 75ºF). The most stable temperatures occur during summer, when water temperature throughout the Jacksonville OPAREA is 27° to 28ºC (81º to 82ºF), with some intrusion of warmer water, about 29ºC (84ºF), around the Gulf Stream.

Salinity in the SAB and in the JAX/CHASN OPAREA ranges from 33 to 36.5 practical salinity units (psu), with lower salinities found near the coast and highest salinities found near the shelf break (Blanton et al., 2003). Variability in salinity is due to the intrusion of saltier (>36 psu) water from over the continental slope, freshwater input from rivers, and coastal run-off (Emery and Uchupi, 1972; Durako et al., 2005; Aretxabaleta et al., 2006). An increase in the salinity of shelf waters is often coincident with an onshore intrusion of the Gulf Stream and upwelling of

Bathymetry in the Site D Area



Site D USWTR

Continental Shelf Break

60 30 0 60 Kilometers

30 15 0 30 Nautical Miles

N

Figure 3.1-4

Path of Gulf Stream

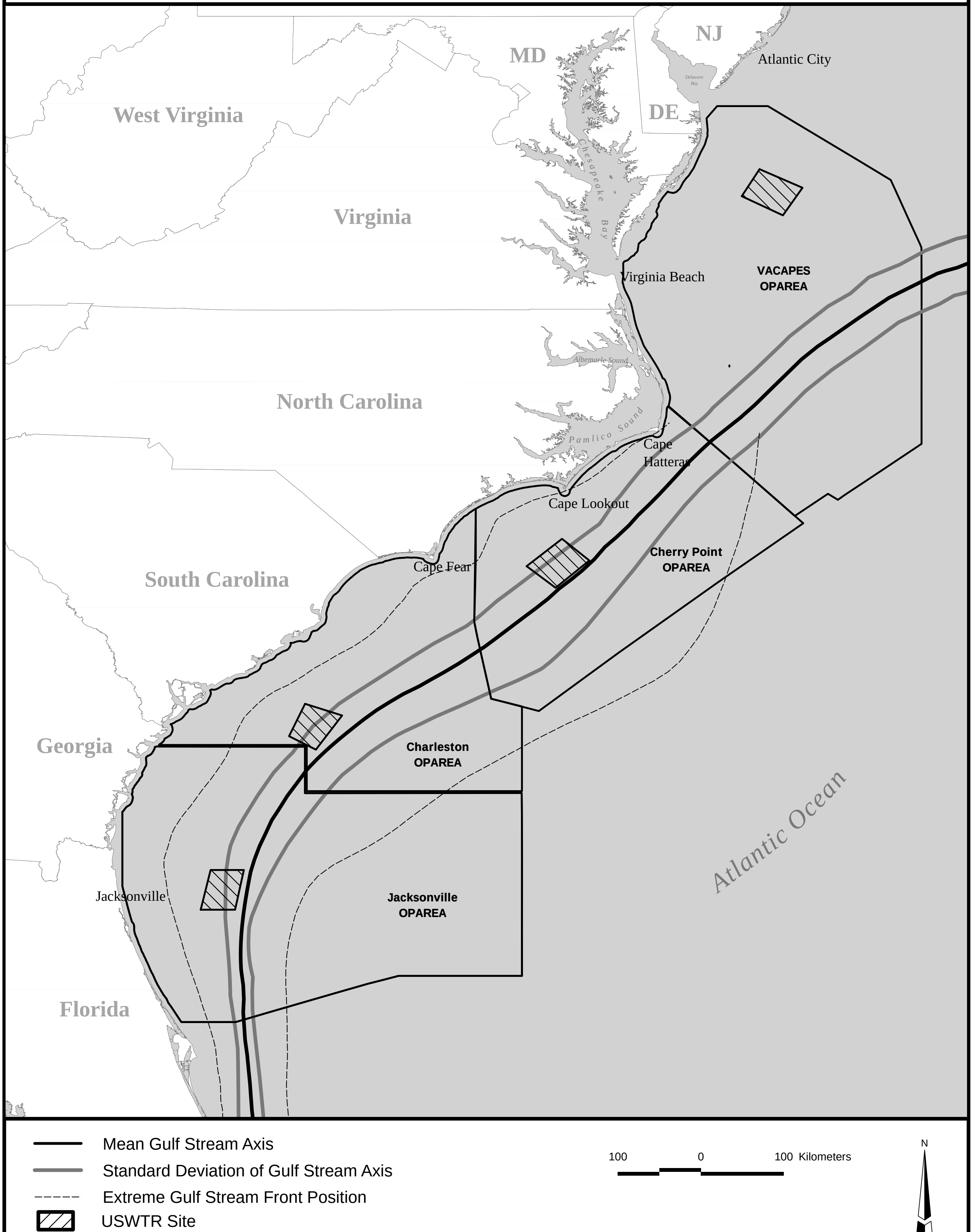


Figure 3.1-5

deep, higher salinity water, although higher salinities do occur farther north than the mean axis of the Gulf Stream (Aretxabaleta et al., 2006).

Circulation

The Gulf Stream is the dominant surface water mass in the SAB and the Jacksonville OPAREA. Southerly flowing currents, which typically occur north of Cape Hatteras, are transient events in the SAB and, when present, are limited to the area along the coast. Circulation over the continental shelf in the SAB is characterized by a broad, slow, northerly flow of water, with frequent intrusions of the Gulf Stream onto the shelf.

As the Gulf Stream enters the Jacksonville OPAREA at a water depth of less than 100 m (328 ft), it is fairly narrow and clearly defined. As the current travels northward and eastward through the OPAREA, it expands to approximately 50 km (27 NM) in width and more than 500 m (1,641 ft) in depth. Surface velocities range from 4.3 to 10.7 km/hr (2.3 to 5.8 knots [kt]), and the water temperature is 25 to 28ºC (77 to 82ºF) (Mann and Lazier, 1996). The west front of the Gulf Stream is variable; the position where it leaves the coast changes throughout the year, sometimes covering Site A (see Figure 3.1-5).

In deep waters within the SAB, currents flow in directions opposite to those of the Gulf Stream. The Deep Water Boundary Current is comprised of several cold, deep-water masses, each with a characteristic temperature and salinity. The Deep Water Boundary Current flows southward towards the equator at depths between 800 and 4,000 m (2,625 and 13,124 ft) along the eastern flank of the Blake Plateau (C. Adams et al., 1993).

3.1.2.2 Site B

Temperature and Salinity

The waters of the Charleston OPAREA, in which Site B is located, undergo an annual cycle of temperature change. Water temperature and salinity are vertically stratified within the Gulf Stream, with salinity increasing and temperature decreasing with increasing depth. During most of the year, there is a clear north-south temperature gradient (with Cape Hatteras being the pronounced dividing line), although this trend is less apparent in summer when surface water temperatures are homogeneous. The surface waters are nearly homogeneous in summer, with almost uniform surface temperatures of 26 to 28^{o}C (79 to 82^{o}F). Temperatures are cooler during winter months, about 10 to 16^{o}C (50 to 60^{o}F) (NOAA, 2007a). Salinity in the SAB and in the JAX/CHASN OPAREA ranges from 33 to 36.5 psu, with lower salinities found near the coast and highest salinities found near the shelf break (Blanton et al., 2003).

Circulation

As previously discussed, the Charleston Bump is a unique feature that exists off the coast of South Carolina and Georgia that influences the flow of the Gulf Stream in this area. The Charleston Bump rises off the surrounding Blake Plateau from 610 m (2,000 ft) deep to a depth of about 366 m (1,200 ft). The offshore deflection of the Gulf Stream by the Charleston Bump causes large meanders and eddies in the region between the Charleston Bump and Cape Hatteras (Verity et al., 1993). Just downstream of the Charleston Bump is an area where a nearly-persistent eastward displacement of shelf water causes the formation of the cyclonic circulation known as the Charleston Gyre. The gyre maintains its circulation shoreward of the Gulf Stream off of Long Bay, South Carolina. This semi-persistent feature causes the macroalgae *Sargassum* and multiple species of ichthyoplankton to be retained on the Florida-Hatteras Shelf offshore of South Carolina.

The offshore deflection of the Gulf Stream by the Charleston Bump has been observed to vary in magnitude, such that the state of the deflection is typically described as either weak or strong (Bane et al., 2001). Whether the magnitude of the deflection is weak or strong also seems to affect the organization of the Charleston Gyre (Bane et al., 2001). When the Gulf Stream is strongly deflected offshore, the gyre is in its most persistent state and fewer meanders in the Gulf Stream occur between the Charleston Bump and Cape Hatteras. When the Gulf Stream is weakly deflected, meanders and eddies are spun off downstream of the bump, causing the gyre to oscillate in strength and organization (Bane et al., 2001). The transition in the Gulf Stream from a weakly deflected state to a strongly deflected state can occur in a matter of days (Bane et al., 2001).

3.1.2.3 Site C

Temperature and Salinity

The waters of the Cherry Point OPAREA in which Site C is located exhibit a clear north-south gradient of increasing sea surface temperature (SST) during most of the year, although this trend is less apparent in summer when the surface temperatures are nearly homogeneous (DoN, 2008l). The Gulf Stream's intrusion into the Cherry Point OPAREA regulates surface and subsurface temperatures in all seasons, reducing the magnitude of seasonal temperature fluctuations. Over the course of the year, nearshore waters undergo more than a 20°C (68°F) temperature change (Newton et al., 1971).

Near-bottom shelf waters are about 5°C (41°F) off Cape Hatteras in winter and increase eastward to about 10°C (50°F) and southward to as high as 20°C (68°F) (Newton et al., 1971). In summer, bottom waters range from about 10 to 25°C (50 to 77°F), with temperature gradually increasing shoreward along the shelf. Bottom temperatures along the shelf break range from about 9 to 11°C (48 to 52°F) in winter with significantly colder (2 to 6°C [36 to 43°F]) bottom waters found inshore just north of Cape Hatteras (S. Cook, 1988).

Water temperatures are at the minimum in winter, with a well defined thermal convergence of cold, northern waters and warm Gulf Stream waters off Cape Hatteras (DoN, 2008l). In spring the water column begins warming, and the thermal convergence area moves north of Cape Hatteras and closer to the mouth of Chesapeake Bay. As late spring progresses into early summer, a seasonal thermocline is established in the waters of the Cherry Point OPAREA and throughout the region. Isotherms (lines of constant temperature) incline steeply seaward. In early summer, the surface temperature contrast in the Cherry Point OPAREA is no greater than anywhere else along the U.S. east coast. The surface waters are almost homogeneous in summer, with nearly uniform surface temperatures over the entire OPAREA. The thermocline reaches its maximum stability shortly before cooling begins in fall.

The salinity over the continental shelf ranges from 28 to 36 psu, with lower salinities nearest the coast and the highest salinities found near the continental shelf break or near Cape Hatteras (DoN, 2008l). The variability is due to the intrusion of saltier water (> 35 psu) from the continental slope waters and freshwater input from coastal sources with the most dominant source of fresh water being the Chesapeake Bay outflow (Garland and Zimmer, 2002; Lentz et al., 2003; Dzwonkowski and Yan, 2005). A salty wedge of water can be seen intruding onto the shelf in the Cape Hatteras area during every season and in particular during winter when the average salinity reaches 36 psu (S. Cook, 1988). This high salinity intrusion onto the shelf appears to be coincident with the average path of the Gulf Stream through the area, although higher salinities do occur farther north than the mean axis of the Gulf Stream. Continental slope waters in the Cherry Point OPAREA maintain a fairly uniform salinity range (32 to 36 psu) throughout the year, with pockets of higher salinity water (38 psu) found near the Gulf Stream's north wall in the fall.

Circulation

The Gulf Stream is the dominant surface water mass or current in the Cherry Point OPAREA. In this OPAREA, the Gulf Stream is about 100 km (54 NM) wide and 1,000 m (3,280 ft) deep (Gyory et al., 2005). Surface velocity ranges from 3.7 to 9.3 km/hr (2 to 5 kt), with a temperature range of 25 to 28^{o}C (77 to 82^{o}F). The position of the Gulf Stream in the Cherry Point OPAREA and where it leaves the coast (see Figure 3.1-5) are variable throughout the year due to a number of oceanographic and atmospheric influences, but generally the Gulf Stream overlaps with Site C. Influences include water column stratification, the North Atlantic Oscillation (NAO), and instability in the mean flow past Cape Hatteras (Taylor and Stephens, 1998; Schmeits and Dijkstra, 2000; Pershing et al., 2001)

The continental shelf waters of Onslow Bay are typical of coastal SAB waters, and can be subdivided into three distinct flow regimes: the inner shelf, mid-shelf, and outer shelf (DoN, 1995b). Due to river runoff, a band of relatively low-salinity stratified water characterizes the inner shelf (0 to 20 m [0 to 66 ft]). Local wind action influences the flow and sea-level variability. Surface and bottom currents on the inner shelf are weak (less than 0.2 km [0.1 kt]) and variable in direction.

Winds also influence the currents in the mid-shelf zone (20 to 40 m [66 to 131 ft]). Stratification occurs seasonally, with well-mixed conditions characterizing fall and winter, and vertical stratification during spring and summer. Measurements taken in 40-m (131-ft) depths in the mid-shelf region indicate moderate tidal influence, with a maximum tidal current at the surface of 1.1 km/hr (0.6 kt) and at the bottom of 0.6 km (0.3 kt). During storms, currents of up to 2.8 km/hr

(1.5 kt) and 1.1 km/hr (0.6 kt) can occur at the surface and bottom, respectively (Pietrafesa et al., 1978).

The outer shelf at Onslow Bay is influenced by the Gulf Stream. The current constantly scours the seabed, and plants and animals are transported in the main axis of the current or concentrated along strong thermal gradients associated with boundaries of the current.

3.1.2.4 Site D

The continental shelf waters off Wallops Island, Virginia, are located in the MAB that extends from Nantucket Shoals, Massachusetts, to Cape Hatteras, North Carolina. Among the large rivers and estuaries that discharge fresh water into the MAB are the Hudson River, Delaware Bay, and Chesapeake Bay.

Temperature and Salinity

During most of the year, there is a clear gradient of increasing SST from north to south in the VACAPES OPAREA; this trend is less obvious in summer when the range in surface water temperatures is smallest (DoN, 2008m). Water temperatures in the OPAREA reach a minimum in winter with a well defined thermal convergence of cold, northern waters and warm Gulf Stream waters off of Cape Hatteras. The effects of the Gulf Stream are most noticeable in the southern portion of the VACAPES OPAREA where seasonal SST ranges from a low of approximately 21°C in winter to 31°C in summer (70° to 88°F). Just north of Cape Hatteras, the Gulf Stream separates from the coast, and waters on the continental shelf near the mouth of Chesapeake Bay undergo a much wider seasonal cycle, ranging in temperature between 8° and 26°C (46° to 79°F) (DoN, 2008m).

Salinity over the southern Hatteras-Cape Cod Shelf ranges between 30 and 35 psu throughout most of the year with variability dependent on several factors, including freshwater input, wind stress and whether winds are downwelling-favorable or upwelling-favorable, transient storm systems, and the position of the Gulf Stream (Kim et al., 2001; Emery and Uchupi, 1972). Increases in salinity over the shelf are often associated with persistent southerly upwelling-favorable winds (i.e., winds out of the south). Cross-shelf currents with speeds of 0.7 km/hr (0.4 kt) have been observed at the frontal boundary between saltwater intrusions and the fresher shelf water, resulting in the onset of instabilities along the front and mixing between the two water masses. Intrusions typically initiate rapidly and persist for only a short period of time (~hours), and in addition to upwelling-favorable winds, may also result from Gulf Stream meanders and warm-core eddies (Flagg et al., 1994; Kim et al., 2001).

Circulation

The Gulf Stream flows northward along the U.S. southeast coast, and is the dominant surface current in the western North Atlantic, SAB, and VACAPES OPAREA. In addition to the Gulf Stream, which flows through the southern half of the VACAPES OPAREA immediately after diverging from the coast off of Cape Hatteras, currents originating from the outflow of both Chesapeake Bay and Delaware Bay influence the surface circulation in the OPAREA (DoN, 2008m). The Chesapeake Bay plume flows seaward from the mouth of the bay and then turns south to form a coastal jet that can extend as far as Cape Hatteras. Similarly, the Delaware Coastal Current initiates in Delaware Bay and flows southward along the DELMARVA Peninsula before being entrained into the Chesapeake Bay plume.

On average, surface currents over the Florida-Hatteras Shelf move slowly to the northeast, and surface currents over the Hatteras-Cape Cod Shelf move to the southwest until a confluence of the two water masses occurs just north of Cape Hatteras (Emery and Uchupi, 1972; Pickard and Emery, 1990). However, reversals in the direction of flow over the shelves have been observed and tend to coincide with changes in the direction of the prevailing winds and low river discharge (Emery and Uchupi, 1972). The Gulf Stream and its meanders strongly influence the general flow of currents over the Florida-Hatteras Shelf, whereas remnants of the southeasterly flowing Labrador Current, located upstream of the VACAPES OPAREA, direct the flow of the cold, temperate waters over the Hatteras-Cape Cod Shelf, as well as the slope water found just beyond the shelf break (Emery and Uchupi, 1972; GoMOOS, 2005).

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3.2 Ecology

This subchapter presents an overview of the biological communities present at the four alternative USWTR sites and the surrounding OPAREAs, which were used to provide a regional context for the discussions. Thus, the following sections refer in many cases to the entire OPAREAs. However, it should be noted that in every case, the USWTR sites encompass only a small portion of each of the OPAREAs (as described in Chapter 2 and depicted in Figure 2-11; Figure 2-15, Figure 2-19, and Figure 2-23).

3.2.1 Plankton

The information presented herein regarding plankton is general in nature and is applicable to all aquatic environments. Plankton refers to organisms that passively float or weakly swim in water. While planktonic organisms may have some locomotory ability, they generally do not have enough power to counteract major ocean currents or turbulence. The majority of planktonic organisms are, at most, a few centimeters in length (less than an inch).

There are two principal groups of plankton – phytoplankton and zooplankton. Phytoplankton includes planktonic plant life, typically microscopic algae such as diatoms, dinoflagellates, and blue-green algae. Zooplankton, or animal plankton, provides the intermediate link between primary producers, such as phytoplankton, and secondary consumers, such as macroinvertebrates and fish. Zooplankton can include organisms that spend their entire life as plankton, such as copepods, cladocerans, and rotifers, or those that spend only a portion of their life as plankton, such as larvae of benthic invertebrates, benthic chordates, and certain fish. Larval fish are discussed in Subchapter 3.2.3.

3.2.2 Macroinvertebrates

Macroinvertebrates along the continental shelf off the coasts of Florida, North and South Carolina, and Virginia, have been studied in detail, and are summarized below for the four alternative USWTR site locations.

3.2.2.1 Site A

The Jacksonville OPAREA has considerable live hard bottom (e.g., Gray's Reef and the Charleston Bump), particularly off the coast of Georgia, well north of the proposed USWTR site. This area has warm water temperatures from the Gulf Stream current (~16°C [61°F] in January to ~29°C [84°F] in August), high salinities (34.3 to 36.6 practical salinity units [psu]), and consistent circulation patterns (northward flowing current) year to year (Wenner et al., 1984; NDBC, 2005; GRNMS, 2006).

Within the Jacksonville OPAREA, the Blake Plateau provides habitat for deep sea corals and sponges (Reed et al., 2006). The Blake Plateau consists of a flat portion of the continental slope that runs from the Bahamas Banks to North Carolina and supports non-reef forming corals and sponges, invertebrates including mollusks, echinoderms, and crustaceans, and fish (Milliman and Wright, 1987; Popenoe and Manheim, 2001). Most corals and sponges live on the inner region of the Blake Plateau north of 31°45'N latitude (Popenoe and Manheim, 2001). Temperate anthozoans found on the continental shelf include octocorals, such as gorgonians, soft corals, and telastaceans (DoN, 2008n). These octocorals may consume zooplankton in addition to using photosynthesis for nutrition (Huntsman and Macintyre, 1971; BLM, 1976; Reed, 1980; W. Miller, 1995).

Deep sea corals (ahermatypic corals that do not contain symbiotic algae) are also found along the continental slope (George, 2002; S. Ross, 2004; FFWCC, 2005b). Deep sea corals are fragile habitats that are now believed to contain more species than their shallow water counterparts but face serious danger from man-made threats, such as crushing by bottom fishing gear, ocean dumping, and mineral exploration (Freiwald et al., 2004). The two most abundant deep sea corals found in the Jacksonville/Charleston OPAREA are *Lophelia pertusa* and *Enallopsammia profunda* (Popenoe and Manheim, 2001; Reed and Ross, 2005).

Lophelia pertusa is an ahermatypic hard coral found in all oceans but polar. Its global depth range is 60 to 2,170 m (197 to 2,170 ft). It is found in the Jacksonville OPAREA at water depths between 200 and 1,000 m (656 and 3,280 ft) and temperatures around 10°C (50°F) (Stetson et al., 1962; S. Ross, 2004; NOAA 2005, 2006a). *Lophelia pertusa* can form colonies as tall as 10 m (33 ft), creating cauliflower-like frameworks and coral banks (J. Wilson, 1979; Reed, 1992, 2002). Other benthic fauna usually associated with *L. pertusa* reefs are massive plate-like sponges (e.g., *Pachastrella monilifera*, *Phakellia ventilabrum*) and gorgonians (e.g., *Plumarella pourtalessi*) (Reed, 2002).

Enallopsammia profunda is an ahermatypic hard coral found in the western Atlantic from as far north as Massachusetts and as far south as the Antilles at depths between 146 and 1,748 m (479 and 5,735 ft) (Cairns et al., 1981). *E profunda* is usually associated with *Lophelia pertusa* in the Jacksonville OPAREA and forms colonies up to 1 m (3.3 ft) in diameter (Reed, 2002).

There are three areas that represent substantial deep sea coral habitat within the Jacksonville/Charleston OPAREA: Stetson Reef, Savannah lithoherms, and East Florida. These areas within the Jacksonville/Charleston OPAREA are all found at depths of about 550 m (1,804 ft) or greater (DoN, 2008n) and are therefore well outside of the range area. The Stetson *Lophelia* reefs are an extensive region of *Lophelia* along the eastern Blake Plateau off South Carolina at a depth of 822 m (2,697 ft), the Savannah *Lophelia* lithoterms are an extensive region of lithoherms along the western Blake Plateau off Georgia at a depth of 550 m (1,804 ft), and the east Florida *Lophelia* reefs occur along a 222-km (120 NM) stretch off eastern Florida at a depth 700 to 800 m (2,297 to 2,675 ft) (Reed et al., 2006).

Several commercially important invertebrates such as pink shrimp, rock shrimp (*Sicyonia brevirostris*), and royal red shrimp (*Pleoticus robustus* or *Hymenopenaeus robustus*) are seasonally abundant in the Jacksonville OPAREA (see Subchapter 3.4.2.1). Other species of decapod crustaceans, stomatopod crustaceans, and cephalopods are also found in the area. Additional principal benthic epifaunal groups include mollusks, echinoderms, and anemones. The distribution of epifauna in this area appears to be governed largely by hydrographic patterns and the intermittent influence of the Gulf Stream (Texas Instruments, 1979).

3.2.2.2 Site B

As discussed for Site A, the Jacksonville and Charleston areas contain hard bottom reefs, which represent an important biological resource in the South Atlantic Bight (SAB). Deep coral banks and areas of rocky outcrops occur all along the continental shelf edge from northern Florida to Cape Hatteras at depths of 100 to 500 m (328 to 1,640 ft) (NOAA, 2006b), and serve as popular fishing grounds for commercial fishermen.

There are also many sediment-dwelling infauna (e.g., worms, crustaceans, mollusks, echinoderms) present in this area. Van Dolah et al. (1987) reported a high diversity of macroinfauna, with mean numbers of species ranging from 34 to 70 species / 0.04m^2 (0.43 ft^2), in a study conducted in inner shelf sands off the coast of South Carolina.

The largest and most economically valuable fishery in South Carolina is that for white and brown shrimp (South Carolina Sea Grant, 2007) (see Subchapter 3.4.2.2). This fishery occurs primarily inshore of the proposed range area. A rock shrimp fishery, however, may occur sporadically off of South Carolina in waters from 27 to 55 m (90 to 180 ft), and therefore overlap the more shallow areas of the proposed range (South Atlantic Fishery Management Council [SAFMC], 2004a; South Carolina Department of Natural Resources, 2007a).

3.2.2.3 Site C

North Carolina is considered a warm temperate subtropical region (Cerame-Vivas and Gray, 1966; Moyle and Cech, 1988). The benthic fauna (~211 species) that live on the continental shelf off the coast of North Carolina, in particular around Cape Hatteras, experience dramatic seasonal changes and a narrowing continental shelf that creates challenging conditions (Cerame-Vivas and Gray, 1966). Water temperatures in the winter north of Cape Hatteras (≥4.5°C [40ºF]) are about 6 to 11°C (43 to 52ºF) colder than water temperatures south of Cape Hatteras (11°C [52ºF]) in the winter on the inner- and mid-shelf creating biogeographic provinces (Cerame-Vivas and Gray, 1966).

Biogeographic provinces are large separations in biota due to environmental variables (i.e., temperature and currents) (Cerame-Vivas and Gray, 1966). Although biogeographic provinces exist, species diversity remains high throughout the year across the shelf in the Cherry Point OPAREA (Kirby-Smith, 1989). Within the Cherry Point OPAREA and vicinity, live hard bottom and biogenic reef communities are found at depths between 3 and 500+ m (10 and 1,640+ ft)

(SAFMC, 1998a; Street et al., 2005). Thirty percent of the shelf area within a 200-m (656-ft) isobath from North Carolina to Cape Canaveral, Florida (South Atlantic Bight) is live hard bottom (biogenic reef) habitat, most of which is macroalgae (SAFMC, 1998a).

Common species found inhabiting (in and around) the reefs in the northern shelf regions of the Cherry Point OPAREA (i.e., north of Cape Hatteras) are sponges, arthropods, gastropods, and echinoderms (Cerame-Vivas and Gray, 1966). This region has more temperate fauna and lower species diversity due to a lack of warm water from the Gulf Stream current, which is farther out in the Atlantic and does not cross over the shelf as it does south of Cape Hatteras (Cerame-Vivas and Gray, 1966).

The benthic fauna of the shelf region south of Cape Hatteras consist of more subtropical species due to a wider continental shelf, increased hard bottom and biogenic reefs, and warmer water mixing from the Gulf Stream Current (Menzies et al, 1966). The benthic fauna here include sponges, hard and soft corals, bryozoans, annelids, mollusks, arthropods, and echinoids (Cerame-Vivas and Gray, 1966; Menzies et al, 1966). Higher abundances of benthic fauna tend to aggregate not only on hard bottom and biogenic reefs but also in the adjacent soft sediment near these areas (1 to 75 m [3 to 246 ft]) due to the availability of prey associated with them (Kirby-Smith, 1989; Posey and Ambrose, 1994).

There are no tropical coral reefs within the Cherry Point OPAREA or vicinity but there are isolated coral patches, sea fans, algae, and sponges associated with hard bottom (Huntsman and Macintyre, 1971). In particular, the Ben Franklin temperate reef, 20 m (60 ft) deep, is located within Onslow Bay, at 33°59’63”N, 77°21’18”W (George, 2002). The Ben Franklin temperate reef is well known for its abundance of compact ivory tree coral (*Oculina arbuscula*), macroalgaes, and a reef isopod (*Eurydice bowmani*) (George, 2002). Other scleractinian corals found in Onslow Bay are *Solenastrea hyades*, *Siderastrea siderea*, ivory tree coral (*Oculina varicosa*), *Astrangia astreiformis*, *Phyllangia americana*, and *Ballanophyllia floridana* (Huntsman and Macintyre, 1971). In addition to hard corals, soft corals such as *Titanedeum frauenfeldii* and *Telesto fructiculosa* and four species of sponges (*Homaxinella waltsonsmithi*, *Spheciospongia vesparium*, *Cliona caribbaea*, and *Halichondria bowerbanki*) are also abundant on the reefs throughout the shelf (NCDMF, 2005a).

Two deep sea coral banks (*Lophelia pertusa*), the northern and southern *Lophelia* banks, exist within the slope area of the Cherry Point OPAREA in water depths between 200 and 1,000 m (656 to 3,280 ft), (Stetson et al., 1962; S. Ross, 2004; NOAA, 2005, 2006a).

The northern *Lophelia* banks exist off Cape Lookout (500-m [1,640-ft] isobath). They appear to have abundant *L. pertusa* but size and area data are lacking. The northern *Lophelia* banks grow on top of a ridge system composed of dead coral rubble and trapped sediments. The *Lophelia* banks extend vertically 80 m (262 ft) over a distance of 1 km (0.5 NM). Abundant numbers of brittle stars (*Ophiacantha bidentata*), crabs (galatheid), and basket stars (*Novodinia antillensis*) forage the banks for food, suggesting a biologically rich environment. The southern *Lophelia* banks are very similar to the northern *Lophelia* banks. They occur off the coast of Cape Fear, North Carolina, along a ridge system (0.4 km [0.2 NM]) (500 m [1,640 ft] isobath) and can grow as tall as 53 m (174 ft) (S. Ross, 2004; Reed and Ross, 2005).

In addition to the *Lophelia* banks there are also two canyons in the Cherry Point OPAREA located between Cape Hatteras and Cape Lookout: Hatteras Canyon and Pamlico Canyon. These canyons support various benthic fauna such as sea pens (*Kophobelemnoon stelliferum* and *Distichoptilum gracile*); anemones (*Actinauge verrilli*); and sponges (*Hyalonema boreale*) (Rowe, 1971; Hecker, 1994).

Commercially important invertebrates such as penaeid shrimp (e.g., white shrimp [*Litopenaeus setiferus*], brown shrimp [*Farfantepenaeus aztecus*], pink shrimp [*F. duorarum*], and portunid crab [*Callinectes similes*]) are seasonally abundant in the SAB (see Subchapter 3.4.2.3). Other species of decapod crustaceans, stomatopod crustaceans, and cephalopods are also found in the SAB.

3.2.2.4 Site D

Hard bottom of the VACAPES OPAREA consists of a variety of naturally occurring and human-made substrates (Steimle and Zetlin, 2000) colonized by sessile and motile benthic organisms, and used by demersal organisms. Benthic communities include hard and soft corals, hydroids, anemones, crustaceans, encrusting algae, sponges, sea turtles, and commercial/recreational fishes (Wigley and Theroux, 1981; A. Jones et al., 1985; Steimle and Zetlin, 2000). Benthic habitats in this area include numerous sand and sand-shell shoals which do not support high biotic diversity. Between shoals, "valleys" carved by currents do support considerable benthic diversity such as annelids and bivalves (Cutter et al., 2000).

There are also four submarine canyons within or near the VACAPES OPAREA: Wilmington, Baltimore, Washington, and Norfolk. These canyons support numerous benthic species (i.e., invertebrates, fish, and coral) and provide habitat for deep sea corals and sponges (primarily at depths between 100 and 2,000 m [328 to 6,562 ft]) along with commercially important fish species (Watling and Auster, 2005). Corals and sponges are found in the canyons despite heavy sedimentation and limited suitable substrates for attachment (Hecker et al., 1980). The upper slope fauna of Baltimore Canyon are similar to the fauna found on the nearby shallow water shelf (Hecker et al., 1980). The most abundant coral in the Baltimore Canyon is the small, white, sea pen (soft coral) (*Pennatula aculeate)*, which lives on soft sediment between 100 and 300 m (328 to 656 ft) (Hecker et al., 1980). The lower slope fauna of Baltimore Canyon (1,400 m+ [4,593 ft+]) have similar species to the upper slope fauna and are mainly composed of soft corals (Alcyonaceans) (Hecker et al., 1980, 1983). Hecker et al. (1980) found crabs (*Geryon quinquedens*) and fish (*Synaphobranchus kaupi*) to be the most abundant deep sea organisms in Baltimore Canyon.

There are no tropical coral reefs within the VACAPES OPAREA or vicinity, but temperate corals are found on the shelf that not only use photosynthesis as a mode of nutrition but also consume zooplankton (Wigley and Theroux, 1981; Steimle and Zetlin, 2000). In addition, deep sea corals that form large coral communities are found along the continental slope between 200 and 1,000 m (656 to 3280 ft) in the VACAPES OPAREA and vicinity (Reed et al., 2006).

The VACAPES OPAREA has some isolated patches of soft and hard corals, hydroids, zoanthids, and sponges that colonize rock outcroppings, artificial reefs, and shipwrecks (Steimle and Zetlin, 2000). The southern region (northern North Carolina) of the VACAPES OPAREA contains more sponge and coral coverage as natural hard bottom increases and warmer water temperatures prevail (Wigley and Theroux, 1981). Seventeen species of hard corals are found from Cape Hatteras to Maine, but only one species is found in shallow water (northern star coral [*Astrangia poculata*]); the remaining species are found in water depths of 100 m (328 ft) and deeper (Cairns and Chapman, 2001). The northern star coral is found in the shallow areas (1 to 35 m [3 to 115 ft]) of the VACAPES OPAREA and vicinity associated with hard bottom such as artificial reefs (Cairns and Chapman, 2001; Figley, 2003).

Whip coral (*Leptogorgia virgulata*) is a soft coral that grows in estuaries and coastal zones between 1 and 20 m (3 to 66 ft) (Kaplan, 1988). Whip coral is common in the Chesapeake Bay (Kaplan, 1988). The most common anthozoans in the VACAPES OPAREA are sea anemones (*Metridium senile*) and hydroids (Wigley and Theroux, 1981; Steimle and Zetlin, 2000). Sponges of the VACAPES OPAREA include *Halichondria* sp., *Polmastia* sp., and the loggerhead sponge, *Spheciosponia vesparia* (Wigley and Theroux, 1981; Steimle and Zetlin, 2000).

Within the VACAPES OPAREA sponges exist in moderate densities along the outer shelf and rise region (Wigley and Theroux, 1981). Finger sponge (*Haliclona oculata*) is found in this region on the inner shelf from 1 to 124 m (3 to 407 ft) and can grow to a height of 46 cm (1.5 ft). In addition to sponges, soft corals (*Alcyonaria*) are found in abundance along the shelf, slope, and part of the rise (Watling and Auster, 2005). *Alcyonaceans* (in water depths greater than 500 m [1640 ft]), such as *Anthomastus* spp., *Acanthogorgia* spp., *Acanella* spp., and *Anthothela* spp., are found within the VACAPES OPAREA. *Paragorgia arborea* and *Primnoa resedaeformis* are also found in the VACAPES OPAREA on the outer continental shelf and upper slope (150 m [492 ft]) (Watling and Auster, 2005).

Besides sponges and soft coral species, several hard coral species also exist on the outer continental shelf within the VACAPES OPAREA, such as *Dasmosmilia lymani* (depth range 48 to 366 m [157 to 1201 ft]) and *Dellocyathus italicus* (403 to 2,634 m [1,322 to 8,642 ft]) (Cairns and Stanley, 1981).

Commercially important invertebrates such as the sea scallop (*Plactopecten magellanicus*) and blue crab (*Callinectes sapidus*) are seasonally abundant in the VACAPES OPAREA (see Subchapter 3.4.2.4). Other species of decapod crustaceans, stomatopod crustaceans, and cephalopods are also found in the VACAPES OPAREA.

3.2.3 Fish

The structure of fish communities depends on abiotic (physical) factors, such as salinity, temperature, and dissolved oxygen, and biotic (biological) factors such as food availability, competition, predation, and habitat requirements. Pelagic fish live in the water column, while demersal fish live near the bottom.

Habitats along the Atlantic continental shelf between the inshore high-tide mark and the edge of the shelf include the inner subtidal or open-water habitats, where the water depth is approximately 50 m (164 ft), and the outer subtidal zone, where water depths range from 50 to 150 m (164 to 492 ft).

The SAB and the Mid-Atlantic Bight (MAB) feature different fish assemblages, largely due to water temperature difference. The SAB features more warm-temperate and subtropical fish species, while the MAB features largely temperate fish species. Some subtropical fish are present in the MAB in the warmer late summer/early fall months. Cape Hatteras is the general transition point between the two regions; that is because the Gulf Stream, characterized previously as a powerful surface current that carries warm water into the cooler North Atlantic, flows roughly parallel to the coastline from Florida to Cape Hatteras. At Cape Hatteras, the Gulf Stream is deflected away from the North American continent.

In addition to water temperature differences, there are differences with respect to the reef fish that are represented in both areas. Although coral reefs do not exist in either of the regions, coral reef-associated fishes are well represented in the SAB due to a combination of the large number of artificial habitats, the warm water from the Gulf Stream, and the pelagic larvae of coral-associated fishes. Artificial habitats are present in the MAB, but these habitats tend to have a low diversity of reef fish compared to the more diverse reef fish communities in the SAB.

Specific information pertaining to the fish assemblages inhabiting the waters of the Atlantic continental shelf and the continental slope off the coasts of Florida, South Carolina, North Carolina, and Virginia relative to the four proposed USWTR sites is contained in the following text. Additional information specific to commercial and recreational fisheries is contained in Subchapters 3.4.2 and 3.4.3, respectively. Subchapter 3.2.8.1 discusses fish species designated as endangered or threatened under the Endangered Species Act (ESA), as well as those designated as species of concern by the National Marine Fisheries Service (NMFS).

3.2.3.1 Site A

The Jacksonville OPAREA is located in the SAB. The dynamic interplay of cold currents from the north and the warm Gulf Stream from the south has profound effects on the fish fauna of the SAB. Population structure, local movements, and regional migrations of many species are the result of seasonal variations in water temperature and current patterns. Fish species move in and out of the area throughout the year based on their thermal tolerances, prey availability, and other environmental/ecological variables. Because of this, fish that are more typical of regions to the north or south of the area may well be represented within the SAB at certain times.

Although the states bordering the Jacksonville OPAREA do not include extensive estuarine areas, those that are present serve as important nursery and maturation areas for various fish species. Many of the fish common to the Jacksonville OPAREA (e.g., snappers, groupers, drums, and croakers) are developmentally and ecologically linked to estuaries. Other species spend their entire lives in the open, offshore waters. The Jacksonville OPAREA contains different habitats that support various fish assemblages, as follows:

- **Coastal:** The habitat encompassed by the coastal fisheries extends from the shore seaward across the continental shelf to the shelf break. Although hermatypic coral reefs do not exist in the SAB (within Site A), fish typically associated with coral reefs (e.g., black sea bass [*Centropristis striata*], red snapper [*Lutjanus campechanus*], triggerfishes) are still common in the Jacksonville OPAREA. While much of the continental shelf of the SAB is relatively featureless, occasional patches of complex structural habitat (e.g., live/hard bottom, shipwrecks, and constructed artificial reefs) exist that attract reef fish. The combination of habitat complexity, warm water from the Gulf Stream, and pelagic larvae of coral reef-associated fish results in significant assemblages of reef fish in the Jacksonville OPAREA.

- **Open Shelf:** Pelagic fish species (e.g., tuna, marlins, swordfish) spend their entire lives in the water column in offshore waters. Different species may be associated with particular portions of the water column (i.e., mid-water and near-surface habitats). Pelagic fish sometimes aggregate for feeding and breeding along oceanfronts, including those oceanfronts associated with the Gulf Stream.

- **Shelf Edge:** The shelf edge occurs between the coastal habitats of the shelf and the continental slope. Live/hard bottom is common along this region, primarily composed of jagged broken bottom where groupers, snappers, and porgies congregate. Examples of species associated with this habitat include the hogfish (*Lachnolaimous maximus*), gag (*Mycteroperca microlepis*), black grouper (*Mycteroperca bonaci*), red snapper, vermilion snapper (*Rhomboplites aurorubens*), gray triggerfish (*Balistes vetula*), and bigeye (*Priacanthus arenatus*), among others.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the trunk cable corridors. Table A-1 in Appendix A presents a list of the fish species that may occur in Site A or in the associated trunk cable corridor.

3.2.3.2 Site B

Like the Jacksonville OPAREA, the Charleston OPAREA is located in the SAB. The description in Subchapter 3.2.3.1 of the fish assemblages inhabiting the waters of the Jacksonville OPAREA and Site A also applies to the Charleston OPAREA and Site B.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the truck cable corridors. Table A-2 in Appendix A presents a list of the fish species that may occur in Site B or in the associated trunk cable corridor.

3.2.3.3 Site C

The fish in the Cherry Point OPAREA are diverse, with more than 686 fish representing 149 families (DoN, 2008l). However, none of the species within the OPAREA are listed as threatened or endangered under ESA. Most fish species in the Cherry Point OPAREA are associated with the subtropical/tropical (southern) fauna attributable to the Gulf Stream, although a large percentage of fish are migratory (as they follow temperature gradients).

North Carolina has an extensive network of estuaries that function as breeding grounds, feeding grounds, and havens from predation for many fish species. Many of the fish common to the Cherry Point OPAREA utilize estuaries at some phase of their life cycle. Other species spend their entire lives in the open, offshore waters. The Cherry Point OPAREA contains different habitats that support various fish assemblages, as follows:

- **Coastal:** Coastal fisheries habitat begins beyond the Outer Banks, extends north and south along the entire length of the North Carolina coast, and seaward along the gradually sloping bottom to a depth of 110 m (361 ft). Fish assemblages within this habitat vary greatly, depending on time of year and associated water temperatures and currents. For example, in the summer, numerous pelagic fish exist in the water column, but demersal fish, with the exception of sharks, move into deeper, cooler, offshore waters. In the fall (September and October), most fish migrate out of the sounds or estuaries to the south or from offshore waters into nearby shelf waters to spend the winter.

- **Open Shelf:** The open-shelf habitat to the south of Cape Hatteras abounds seasonally with oceanic pelagic fish, such as sharks, tunas, and marlins, among others. Many of the coastal fish can also be found at some point of the year (depending on the season) in the open shelf or slope habitat. Many flounders and porgies are prevalent in North Carolina shelf waters in the fall; many other species migrate north or south. Fish living in the rough seas over the shelf during the winter months (December to March) typically include dense schools of drums (Sciaenidae), puffers (Tetraodontidae), monkfish (*Lophius americanus*), and spiny dogfish (*Squalus acanthias*), among others.

- **Shelf Edge**: The shelf edge is a transition zone between the coastal habitats, the open shelf, and the continental slope. It has a jagged broken bottom where groupers, snappers, and porgies congregate; otherwise, little is known about the fish of this habitat because strong currents limit sampling. Live/hard bottom is found at or near the shelf edge. Primary reef species require structurally complex habitats. Examples of species associated with this habitat include black sea bass, tautog (*Tautoga onitis*), red snapper, silk snapper (*Lutjanus vivanus)*, pinfish (*Lagodon rhomboides*), crested blenny (*Hypleurochilus geminatus*), gray triggerfish, and bigeye, among others.

  South of Cape Lookout, the lower shelf has a gradual slope and bottom sediments are typically comprised of fine- and medium-grained sand and silty clay. Species in the Macrouridae (rattails and grenadiers) and Gadidae (cods) families have been found using the muddy bottom of the lower shelf edge.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the truck cable corridors. Table A-3 in Appendix A presents a list of the fish species that may occur in Site C or in the associated trunk cable corridor.

3.2.3.4 Site D

The VACAPES OPAREA is located in the southern portion of the MAB, in the region between Cape Cod and Cape Hatteras that forms the Virginian Transition Province. While there are distinct fish assemblages in the boreal (cold-temperate) waters north of Cape Cod and in the subtropical/tropical (warm-temperate) waters south of Cape Hatteras, there are few endemic fish species in the variable MAB waters. Fish species composition, however, is diverse since numerous species, including commercially and recreationally important species, migrate seasonally through this region. At least 250 fish species may occur in the MAB, including demersal and pelagic fish.

There is significant overlap of cold-temperate and warm-temperate species and dramatic seasonal shifts in their distribution. Warm-water species such as bluefish (*Pomatomus saltatrix*) and weakfish (*Cynoscion regalis*) enter the region as temperatures rise in the spring and summer, while cold-water species such as Atlantic cod (*Gadus morhua*), Atlantic herring (*Clupea harengus*), and American shad (*Alosa sapidissima*) migrate north. Similarly, as fall approaches, warm-water species may migrate offshore toward deep waters and then move southward, while cold-water species move south into the MAB areas.

The MAB contains different habitats that support various fish assemblages, as follows:

- **Coastal:** Coastal habitat includes that area from the continental shelf break inshore. Sharks are a well-represented group in the VACAPES OPAREA. Other coastal pelagic fish species include Atlantic mackerel (*Scomber scombrus*), Atlantic menhaden (*Brevoortia tyrannus*), bluefish, alewife, and butterfish (*Peprilis triacanthus*).

- **Open Shelf:** Pelagic fish of the open shelf are highly migratory and include tuna (*Thunnus* spp.), white marlin (*Tetrapterus albidus*), blue marlin (*Makaira nigricans*), sailfish (*Istiophorus platypterus*), swordfish (*Xiphias gladius*), wahoo (*Acanthocybium solandri*), and dolphinfish (*Coryphaena hippurus*). All life stages (i.e., eggs, larvae, juveniles, adults) of these species are closely associated with the Gulf Stream. Fish associated with the drifting mats of *Sargassum* are also considered to be in the ocean pelagic group; approximately 100 species of fish are associated with pelagic *Sargassum* (SAFMC, 1998). Demersal fish, such as summer flounder (*Paralichthys dentatus*) and windowpane flounder (*Scophthalmus aquosus*), are species that preferentially live on or near bottom habitats.

- **Shelf Edge:** The continental shelf edge habitat is a transition zone between the inshore habitats and the continental slope leading to the abyssal plain. The shelf edge habitat north of Cape Hatteras has a jagged, broken bottom, over which many groupers, snappers, and porgies abound.

The Navy performed a literature search to compile information on the assemblages of finfish species that, based on previous surveys, may occur within the proposed USWTR sites or the trunk cable corridors. Table A-4 in Appendix A presents a list of the fish species that may occur in Site D or in the associated trunk cable corridor.

3.2.4 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801 et seq.), as amended, establishes management authority over all fishing within the U.S. Exclusive Economic Zone (EEZ); all anadromous fish (marine fish that spawn in freshwater) throughout their migratory range; and all fish on the continental shelf. The MSA mandated the formation of eight Fishery Management Councils (FMCs), which function to conserve and manage certain fisheries within their geographic jurisdiction. The councils are required to prepare and maintain a Fishery Management Plan (FMP) for each fishery that requires management. Amendments contained in the Sustainable Fisheries Act of 1996 (Public Law 104-267) require the councils to identify Essential Fish Habitat (EFH) for each fishery covered under a FMP. EFH is defined as the waters and substrate necessary for spawning, breeding, or growth to maturity (16 USC 1802[10]). The term “fish” is defined as “finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds.” NMFS further clarified EFH (50 CFR 600.05 through 600.930) by the following definitions:

- **Waters:** aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate

- **Substrate:** sediment, hard bottom, structures underlying the waters, and associated biological communities

- **Necessary:** the habitat required to support sustainable fisheries and managed species’ contribution to a healthy ecosystem

- **Spawning, breeding, feeding, or growth to maturity:** stages representing a species’ full life cycle

In addition to the regional FMCs, the Atlantic States Marine Fisheries Commission (ASMFC) and NMFS also have management responsibilities for certain fisheries. The ASMFC is a consortium of the 15 coastal states from Florida through Maine that manages fish in state waters. The ASMFC currently manages 22 Atlantic coastal fish species or species groups (ASMFC, 2009). NMFS has jurisdiction over highly migratory species (HMS) in federal waters off the U.S. Atlantic coast and Gulf of Mexico. Typically, both the ASMFC and NMFS work closely with regional FMCs in preparing and implementing fishery management strategies.

As required by the MSA, federal agencies must consult with NMFS, Habitat Conservation Division, on any proposed federal action that may adversely affect EFH. In addition to EFH designations, areas called Habitat Areas of Particular Concern (HAPC) are designated to provide additional focus for conservation efforts and represent subsets of designated EFH that are rare, especially important ecologically to a species/lifestage, particularly susceptible to human-induced degradation, or located in environmentally stressed areas (50 CFR 600.805-600.815(a)(8)). HAPCs typically include high-value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish. Categorization as HAPC does not confer additional protection or restriction to the designated area.

Recently, the SAFMC and New England Fishery Management Council (NEFMC) have proposed to protect and designate deep-sea canyon and deep-sea coral habitats as HAPC. Some of these areas lie within and/or adjacent to Sites A, B, C, and D (NEFMC, 2007). They provide habitat for deep-sea corals and EFH for many species (J.A. Moore et al., 2003; L.E. Morgan et al., 2005, 2006). In the MAB (Hudson Shelf Valley and Canyon, Norfolk, Baltimore, Washington, and Wilmington canyons) and southeast waters (Savannah, east Florida, Stetson Reef, Cape Fear Banks, and Cape Lookout Banks), deep-sea canyons provide habitat for cold-water (also called deep-sea) corals, including scleractinian corals (stony corals), cerianthid anemones (Cnidaria, Anthozoa, Hexacorallia, Cerianthania), sponges (Porifera), antipatharians (black corals), hydrocorals, and octocorals (gorgonians, soft corals, and sea pens) (Lumsden et al., 2007). These organisms may occur as solitary individuals (e.g., solitary scleractinian corals) and also can form both reef-like structures and thickets that provide habitat for numerous marine species.

Managed fish species may be categorized as temperate, subtropical-tropical, or highly migratory species. The FMCs classify EFH for temperate and subtropical-tropical managed species in terms of five basic lifestages: (1) Eggs, (2) Larvae, (3) Juveniles, (4) Adults, and (5) Spawning Adults. Eggs are those individuals that have been spawned but not hatched and are completely dependent on the egg's yolk for nutrition. Larvae are individuals that have hatched and can capture prey, while juveniles are those individuals that are not sexually mature but possess fully formed organ systems that are similar to adults. Adults are sexually mature individuals that are not necessarily in spawning condition. Finally, spawning adults are those individuals capable of spawning (MAFMC, 1998a, 2000; MAFMC and ASFMC, 1998a, b; MAFMC and NEFMC, 1999, NEFMC, 1998, 1999; SAFMC,1998a).

NMFS categorizes the lifestages of managed tuna, swordfish, and billfish somewhat differently than the FMCs, resulting in three categories that are based on common habitat usage by all lifestages in each group: (1) Spawning Adults, Eggs, and Larvae; (2) Juveniles and Subadults; and (3) Adults. Subadults are those individuals just reaching sexual maturity. The category of Spawning Adults, Eggs, and Larvae is associated with spawning location and the circulation patterns that control the distribution of the eggs and larvae (NMFS, 1999b, d).

NMFS uses a different lifestage classification system for sharks; the system bases the lifestage combinations on the general habitat shifts that accompany each developmental stage. The three resulting categories are: (1) Neonate and Early Juvenile (including newborns and pups less than one year old), (2) Late Juvenile and Subadult (age one to adult), and (3) Adult (sexually mature sharks) (NMFS,1999d). In Amendment 1 to the FMP for the Atlantic Tunas, Swordfish, and Sharks (NMFS, 2003b), the first two lifestages were modified as follows: the Neonate and Early Juvenile category was renamed "Neonate," which primarily includes neonates and small young-of-the-year (born within the year) sharks; and the Late Juveniles and Subadults category was renamed "Juveniles," which includes all immature sharks from young to late juveniles (NMFS, 2003b).

Of the eight FMCs, three have geographic areas of jurisdiction within the four sites evaluated in this report. In addition, NMFS has jurisdiction over HMS throughout these areas. The fisheries and management units (MUs; individual species or groups of species managed through a FMP) for which EFH has been established in the study areas are listed in Table 3.2-1. The EFH Assessment (DoN, 2009g) contains a complete list of EFH species and the life stages found at each of the four sites.

The NEFMC manages nine fishery resources within the EEZ off the coasts of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut. Although none of the four sites evaluated here are within this geographic region, it has jurisdiction over some of the MUs present at the sites. The Northeast Multispecies Fishery consists of 15 species of groundfish (demersal fish) that occupy similar habitats and that are harvested with similar methods. A subset of three (i.e., silver hake [whiting], red hake [ling], and offshore hake [blackeye whiting]) of these species requiring additional management measures comprises the small mesh multispecies fishery, which are managed primarily through a combination of mesh size restrictions and possession limits. In addition to the small mesh multispecies fisheries, the remaining 12 species comprise the large mesh multispecies fisheries. The spiny dogfish fishery is managed jointly by the NEFMC, ASMFC, and Mid-Atlantic Fishery Management Council (MAFMC), which is considered the lead council. The Monkfish MU is jointly managed by the NEFMC and MAFMC, with NEFMC acting as the lead. The Atlantic Herring MU is jointly managed by the NEFMC and ASMFC.

Table 3.2-1

Fish Species and Management Units for Which EFH Has Been Identified in the Study Areas

New England Fishery Management Council Jurisdiction

Atlantic Herring Management Unit
Atlantic Sea Scallop Management Unit
Deep-Sea Red Crab Management Unit
Monkfish Management Unit
Northeast Multispecies Management Unit (15 species)
    Large Mesh Multispecies (12 species)
    Small Mesh Multispecies (3 species)
Northeast Skate Complex Management Unit (4 species)
Spiny Dogfish Management Unit

Mid-Atlantic Fishery Management Council Jurisdiction
Atlantic Mackerel, Squid, and Butterfish Management Unit (4 species) Bluefish Management Unit Spiny Dogfish Management Unit Surfclam and Ocean Quahog Management Unit (2 species) Summer Flounder, Scup, and Black Sea Bass Management Unit (3 species) Tilefish Management Unit Monkfish Management Unit
South Atlantic Fishery Management Council Jurisdiction
Coastal Migratory Pelagics Management Unit (3 species) Coral, Coral Reefs, and Live/Hard Bottom Management Unit (multiple species) Dolphinfish/Wahoo Management Unit (3 species) Golden Crab Management Unit *Sargassum* Management Unit (2 species) Shrimp Management Unit (6 species) Snapper-Grouper Complex Management Unit (73 species) Spiny Lobster Management Unit (2 species)
Calico Scallop Management Unit
Highly Migratory Species - National Marine Fisheries Service Jurisdiction
Billfish Management Unit (3 species) Tuna Management Unit (5 species) Swordfish Management Unit (1 species) Large Coastal Sharks Management Unit (10 species) Small Coastal Sharks Management Unit (4 species) Pelagic Sharks Management Unit (3 species) Prohibited Species Management Unit (6 species)

The MAFMC manages seven fishery resources (including shellfish species: Atlantic surfclam and ocean quahog) in federal waters off the coasts of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. (North Carolina is represented on both the Mid-Atlantic and South Atlantic Fishery Management Councils.) This geographic area includes the VACAPES OPAREA and most of the Cherry Point OPAREA. The Atlantic Mackerel, Squid, and Butterfish MU includes two commercially important squid species (long-finned and short-finned). The MAFMC jointly manages both the bluefish fishery and the summer flounder, scup, and black sea bass fishery group with the ASMFC. The tilefish is managed as a single species MU by the MAFMC, but is also one of the species included in the Snapper-Grouper Complex MU, which is managed by the SAFMC. In addition to the tilefish, the black sea bass is also managed separately by the SAFMC as part of the snapper grouper MU.

The SAFMC manages nine fishery resources in federal waters off the coasts of North Carolina, South Carolina, Georgia, and the east coast of Florida to Key West (SAFMC, 2008). This geographic area includes part of the Cherry Point OPAREA, the Charleston OPAREA, and the Jacksonville OPAREA. Coastal Migratory Pelagic species are managed jointly with the Gulf of Mexico Fishery Management Council (GMFMC). These species are considered a single MU because their occurrence is influenced by similar temperature and salinity parameters. The snapper-grouper complex includes 73 species of tropical and subtropical fish that are generally demersal in nature, occupy the same habitat types, and are harvested with similar methods. This complex includes numerous species of snappers, groupers, sea basses, porgies, grunts, tilefishes, triggerfishes, wrasses, and jacks. The shrimp fishery includes pink shrimp, white shrimp, brown shrimp, royal red shrimp, brown rock shrimp, and seabob shrimp. The spiny lobster fishery is also managed jointly with the GMFMC. Other MUs managed by the SAFMC include the Atlantic calico scallop, golden crab, and the dolphinfish/wahoo complex. The management authority of the red drum, formerly managed jointly by the SAFMC and ASMFC, was transferred from the SAFMC, in cooperation with the MAFMC, under MSA to the ASMFC under the Atlantic Coastal Fisheries Cooperative Management Act on November 5, 2008 (NMFS, 2008a).

In addition to fish species, the SAFMC has prepared FMPs for important habitats including coral, coral reefs, and live/hard bottom and *Sargassum* seaweed. The SAFMC generally divides EFH into inshore/estuarine and offshore categories. Inshore/estuarine EFH includes estuarine and palustrine marshes, shrub/scrub mangroves, seagrass, oyster reefs, shell banks, intertidal flats, aquatic beds, and the estuarine water column. Offshore habitats include live/hard bottom, coral and coral reefs, artificial/manmade reefs, *Sargassum*, and the marine water column.

In keeping with Executive Order 13158 that directs federal agencies to protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs), the NMFS has recently designated eight deepwater MPAs along the southeastern coast of the U.S. as part of the South Atlantic snapper-grouper FMP which was implemented as Amendment 14, effective 12 February 2009 (NMFS, 2009a). The MPAs are designed to protect a portion of the long-lived, "deepwater" snapper-grouper complex species (e.g., snowy grouper, speckled hind, and blueline tilefish) and their spawning grounds. 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 complex species, and any deployment of shark-bottom longline fishing gear are prohibited (SAFMC, 2007c). The SAFMC's proposed prohibition on the use of shark bottom longlines in the MPAs was implemented by NMFS HMS Division in a separate final rule on 24 June 2008 (NMFS, 2008b). 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 purpose 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). These spawning grounds are considered to be HAPC by the SAFMC. 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).

HMS include several species of tunas, sharks, swordfish, and billfish. These species are generally associated with physiographic and hydrographic features such as ocean fronts, current boundaries, the continental shelf margin, or sea mounts. HMS may occur from the open ocean to nearshore waters. HMS in the Atlantic Ocean are managed by the HMS Division of the NMFS.

EFH for managed species and MUs listed in Table 3.2-1 may be characterized with the general habitat categories described below. A complete description of EFH for each species and lifestage may be obtained by contacting the appropriate fishery management council or by visiting the NMFS Office of Habitat Conservation, Habitat Protection Division website (NMFS, 2009i).

3.2.4.1 Site A

The SAFMC is responsible for the fisheries in federal waters off the coast of Florida. The SAFMC published its final EFH plan (SAFMC, 1998a) in the *Federal Register* on March 4, 1999. This plan describes the EFHs of the South Atlantic region (from Cape Hatteras to the Dry Tortugas) and their distribution. The SAFMC maintains FMPs for the following eight MUs: shrimp; snapper-grouper; coastal migratory pelagics; golden crab; dolphinfish and wahoo; spiny lobster; coral, coral reef, and live bottom; and *Sargassum* (SAFMC, 1998a, b, 2009). SAFMC also manages the calico scallop (SAFMC, 2008), for which a FMP is being prepared. Additionally, in the South Atlantic region, NMFS maintains a FMP for the following seven MUs: billfish, tunas, swordfish, small coastal sharks, large coastal sharks, pelagic sharks, and prohibited species (NMFS, 2006b).

As previously discussed, the designated North Florida MPA is located in Site A (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). The EFH Assessment (DoN, 2009g) contains site-specific details of the MUs and managed species, along with EFH maps.

There are eight marine EFHs within the Site A area, including the USWTR range itself (1,535 km² [448 NM²]) and the corridor that connects the range with the shore facility (corridor) (2,085 km² [608 NM²]) (NOAA, 1999; NMFS, 2002a, b; DoN, 2009g). These EFHs include benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, currents, nearshore habitats, and HAPCs.

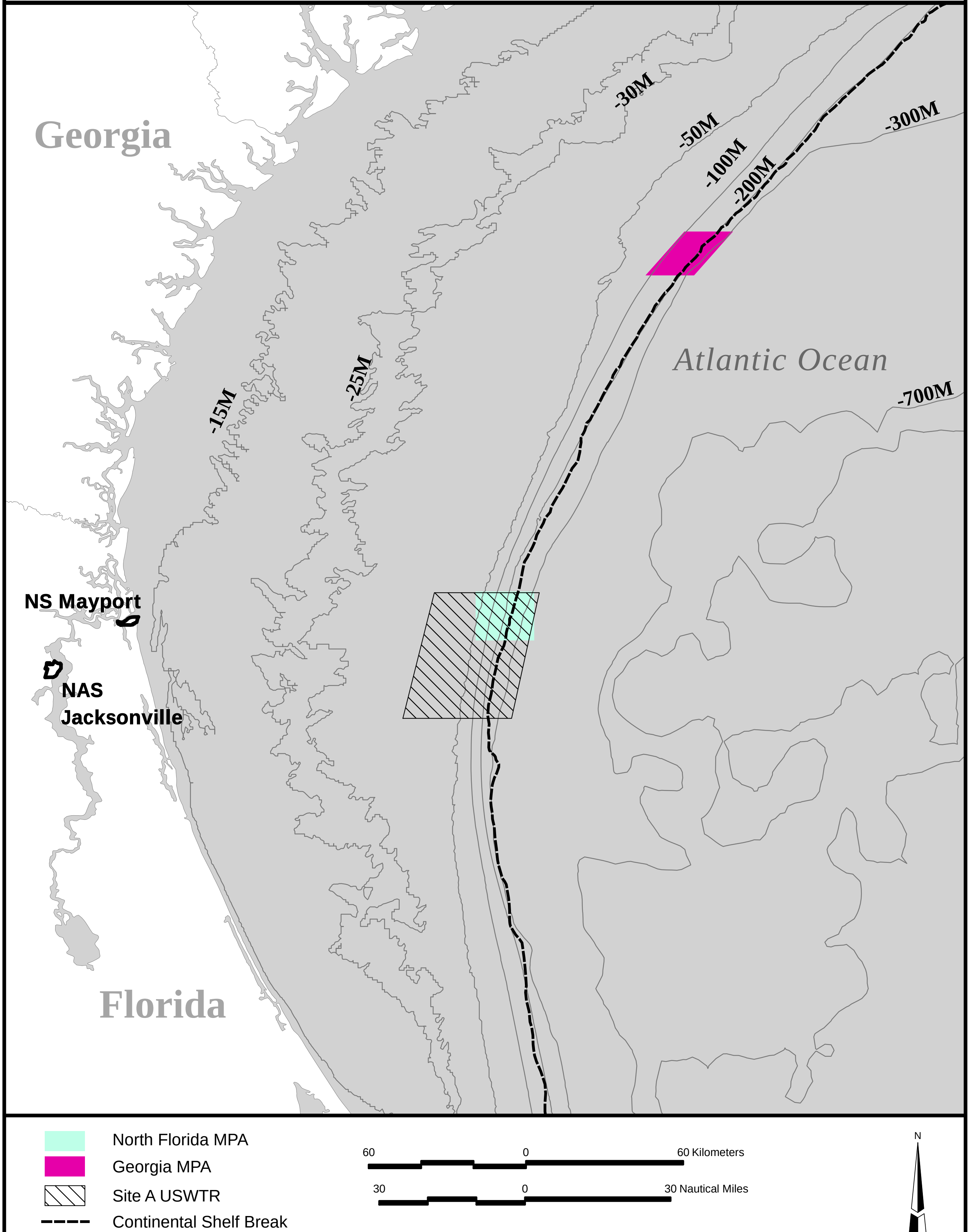
- **Benthic substrates (not including live/hard bottom) –** Benthic substrate habitats comprise seafloor substrate on the continental shelf and slope that consists of soft sediments such as gravel, cobbles, pebbles, sand, clay, mud, silt, and shell fragments, and the water-sediment interface directly above the bottom substrate that is used by many invertebrates (e.g., members of shrimp MU). These benthic substrate habitats are utilized by a variety of species for spawning, nesting, development, dispersal, and feeding (NOAA, 1999, NMFS 1999c, 2002a, b; SAFMC, 1998a).

  The benthic substrates within the range that appear along the outer continental shelf and shelf break (~40 to 100 m [~ 131 to 329 ft]) are mostly carbonate sediments (medium to fine grain) that make up between 50 and 95 percent of sediments on the outer Florida-Hatteras Shelf and the adjacent Florida-Hatteras Slope (A. Jones et al., 1985; Emery and Uchupi, 1972). Further seaward, between 85 and 93 percent of sediments on Blake Plateau are composed of carbonate (A. Jones et al., 1985; Emery and Uchupi, 1972). Within the Site A range, benthic substrates (not including live/hard bottom) comprise 61 percent of the area (935 km² [273 NM²]), while in the corridor, 91 percent (1,888 km² [550 NM²]) is considered to contain benthic substrates. Within the range, 21 species in 11 MUs use benthic substrates (DoN, 2009g). In the corridor area, 18 species in eight MUs use benthic substrates (DoN, 2009g).

- **Live/hard bottom –** Live/hard bottom refers to areas of the seafloor associated with hard substrate such as rocks, boulders, outcroppings of hard rock, or hard, tightly compacted sediments that support communities of living organisms such as sponges, mussels, hydroids, amphipod tubes, red algae, bryozoans, and corals in oceanic waters or oysters and bivalves in inshore waters (SAFMC, 1998a). The SAFMC (1998a) defines live/hard bottom as constituting "a group of communities characterized by a thin veneer of live corals and other biota overlying assorted sediment types." The range is located in the southern portion of the Georgia Bight where the shelf is wide and gently slopes seaward. Throughout the shelf within the range, hard bottom consists of rock scarps, rock ledges, and flat top rocks with undercut channels that support sessile and colonizing organisms (Moser et al., 1995a). The SAFMC does not consider shipwrecks to be EFH.

  Live/hard bottom communities in the training range of Site A are found on a Holocene rock-ridge system that extends along the shelf break (Kirby-Smith,

Marine Protected Areas in and Near Site A

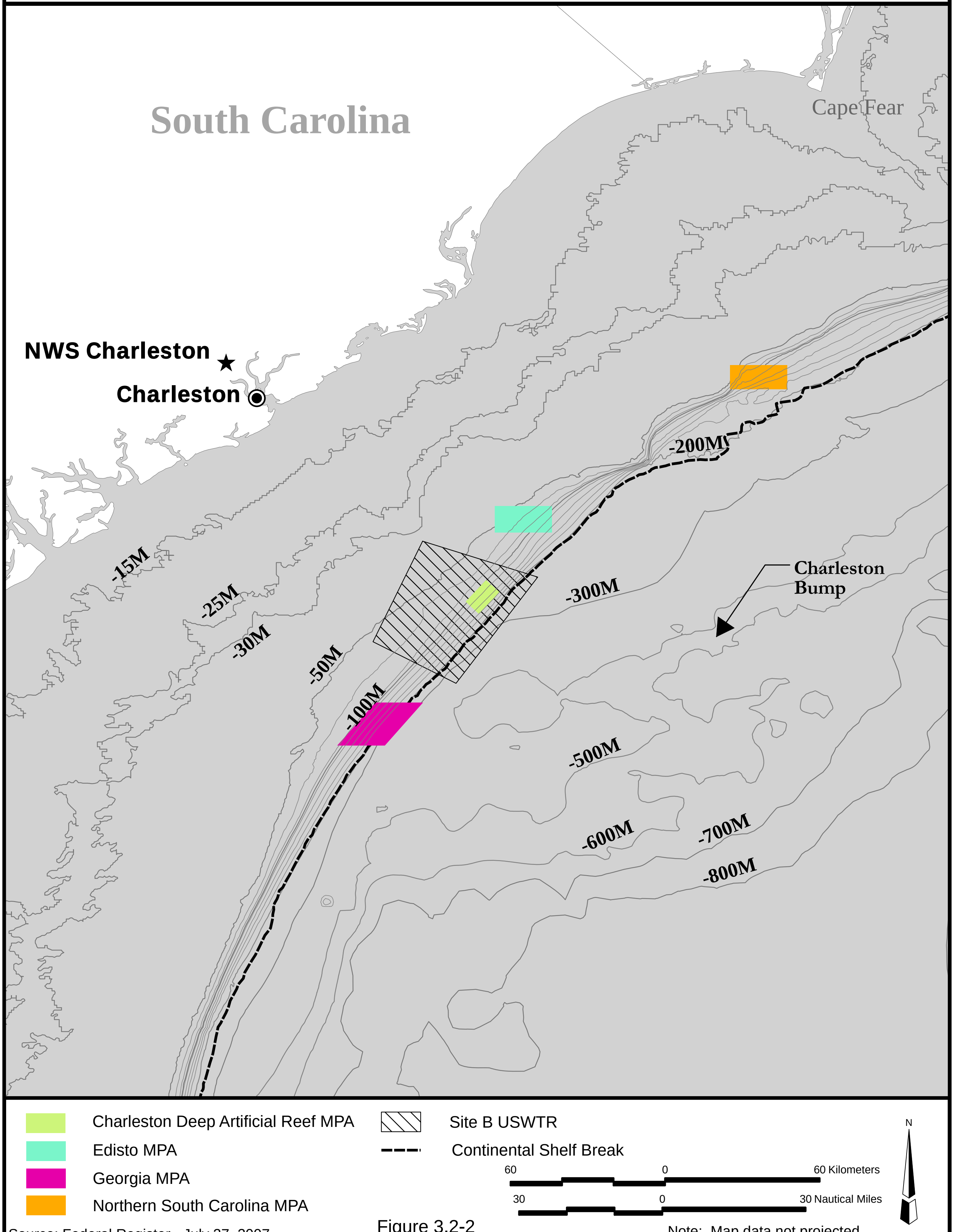


Source: Federal Register - July 27, 2007

Figure 3.2-1

Note: Map data not projected.

Marine Protected Areas in and Near Site B



Source: Federal Register - July 27, 2007

Figure 3.2-2

Note: Map data not projected.

1989; ASMFC, 2001). The rock-ridge system is composed of consolidated sediments, limestone algae, and sandstone (Kirby-Smith, 1989; ASMFC, 2001). Although Site A contains isolated coral patches or mounds (DeVictor and Morton, 2007), there are no true coral reefs similar in size, structure, or composition to those found in the Bahamas or Antilles regions further south.

The live/hard bottom areas constitute essential habitat for various warm-temperate and tropical species of the snapper-grouper complex and associated fishes. Offshore live/hard bottom habitats are used by many adult members of the snapper-grouper MU for feeding, shelter, and spawning (NEFMC, 1998; SAFMC, 1998a).

Within the Site A range, live/hard bottom areas comprise about 39% of the range (600 km² [175 NM²]). In the corridor, nine percent (197 km² [57 NM²]) is considered to be live/hard bottom. Eighteen species in six MUs use the live/hard bottom habitat of the range (DoN, 2009g), while in the corridor, 17 species in five MUs use live/hard bottom habitat (DoN, 2009g).

- **Artificial/manmade reefs –** Artificial/manmade reefs are defined as sea floor areas where suitable structures or materials have intentionally been placed for the purpose of providing long-term habitat for various fish and invertebrates. These types of artificial reefs are designated EFH. While there are no artificial reefs in the range area, there are 106 artificial reef complexes in the corridor area (FFWCC, 2006, 2008). Five species from two MUs use the artificial/manmade reef EFH in the corridor area (SAFMC, 1998a; DoN, 2009g).

- **Pelagic *Sargassum* –** Pelagic *Sargassum* is defined as dynamic structural habitat that is created by free-floating mats (windrows) of brown algae: *Sargassum natans* and *S. fluitans* (Settle, 1993). Most pelagic *Sargassum* circulates between 20^{o} and 40^{o}N latitudes and 30^{o}W longitude and the western edge of the Florida Current/Gulf Stream (SAFMC, 1998a). Large quantities of *Sargassum* can form on the continental shelf off the southeastern U.S., and depending on prevailing surface currents, these mats may remain on the shelf for extended periods. The windrows flow with the Gulf Stream current and act as a type of "food conveyor belt" for many species of fish and invertebrates, transiting from the south to the north (Dooley, 1972; Butler et al., 1983; SAFMC, 1998a). Pelagic *Sargassum* is considered EFH because it provides protection and feeding opportunity; the mats can also be used as a spawning substrate to a variety of fish species (SAFMC, 1998c). Casazza and Ross (2008) reported that *Sargassum* provides a substantial nursery habitat for many juvenile fishes off the U.S. southeastern coastline. Over 100 species of fish have been collected or observed in association with *Sargassum* habitats, including reef, coastal demersal, coastal pelagic, epipelagic, and mesopelagic species. The presence of this habitat within Site A is transient and is dependent on prevailing winds, currents, and seasons (Dooley, 1972). *Sargassum* temperature requirements change seasonally, ranging from 15°C (59°F) in the winter to 28°C (82°F) in the summer months (Garrison, 2004). *Sargassum* is most abundant in the late fall after its summer growth (Butler et al., 1983).

Within Site A, pelagic *Sargassum* habitat has the potential to occur in all of the surface waters in the range and the corridor at any given time. There are 20 species in 3 MUs that use both the range and corridor areas as pelagic *Sargassum* EFH (DoN, 2009g).

- **Water column –** Water column is defined as specific “structural” components of the water column that provide habitat for a broad array of managed species. The structural components of the water column that help define EFH include environmental parameters such as salinity, water temperature, nutrients, and density (SAFMC, 1998a). The water column can be categorized into three layers: the surface water layer (or upper layer), the thermocline/pycnocline, and the deep water layer (Pickard and Emery, 1982; Schmitz et al., 1987). Circulation in the water column is controlled by both wind and water density, with wind-driven circulation dominating in the upper 100 m (328 ft) of the water column (Schmitz et al., 1987) and density-driven (or thermohaline) circulation in water depths generally greater than 100 m (328 ft) (Picakard and Emery, 1982; Schmitz et al., 1987). Planktonic organisms support the oceanic food web and provide nutrition for many commercially important fish species (Parsons et al., 1984). Planktonic organisms drift with currents and are found throughout the water column within the range.

  The water column extends from the sea surface to a depth of 40 m (131 ft) in the corridor and from the sea surface to a maximum depth of 400 m (1,312 ft) in the range. Depending on the species, designated habitat may only refer to part of the water column such as the surface or bottom waters. Within Site A, the water column overlies the range and corridor to areas of 1,535 km^2 (448 NM^2) and 2,085 km^2 (608 NM^2), respectively. The water column as EFH supports 39 species in 13 MUs in the range area and 39 species in 11 MUs in the corridor area (DoN, 2009g).

- **Currents –** Here currents refer to surface circulation features of the southeastern U.S. dominated by the Gulf Stream that provides a dispersal mechanism for the larvae of many fish and invertebrate species (SAFMC, 1998a). The Gulf Stream is preceded by the Florida Current and flows to the northeast over deep water from southern Florida to Cape Hatteras, North Carolina, and then east into the northern Atlantic Ocean (Bumpus, 1973; Pickard and Emery, 1982). The Gulf Stream is bordered to the west by cool nearshore and slope waters and to the east by the warm Sargasso Sea. Currents west of the Gulf Stream are those that influence the range and corridor areas. Circulation over the continental shelf in the Site A area is characterized by a slow and broad northerly flow. Further, currents over the shelf fluctuate seasonally and are predominantly wind-driven, but are also influenced by tides, transient storm systems, changes in density caused by fresh water input, and intrusion by Gulf Stream waters (Shen et al., 2000; Marmorino et al., 2002; Lentz et al., 2003). Frontal eddies commonly form when the distance between the Gulf Stream and the coast is greatest, such as off the coast of northern Florida (Yoder et al., 1981). Within Site A, currents as EFH influence the entire water column of the range (1,535 km^2 [448 NM^2]) and 69 percent of the potential corridor (1,432 km^2 [418 NM^2]). Twenty-nine species in nine MUs use currents as EFH (DoN, 2009g).

- **Nearshore** – Nearshore is defined as state waters (i.e., waters from estuaries to 5.5 km [3 NM] from shore), which include tidal freshwater, estuarine emergent vegetated wetlands (i.e., flooded salt and brackish marshes, marsh, and tidal creeks), submerged rooted vascular plants (sea grasses), oyster reefs and shell banks, soft sediment bottom, hard bottom, ocean high salinity surf zones, artificial reefs, and estuarine water column (SAFMC, 1998a). There are no nearshore habitats in the range area. Only 0.3 percent (6.9 km^2 [3.7 NM^2]) of the 2,085-km^2 (608-NM^2) corridor within Site A is designated as nearshore EFH. Nearshore EFH includes the water column, submerged aquatic vegetation (SAV), and other hard and soft benthic substrates. The nearshore EFH of the corridor area is used by 45 species in 14 MUs (DoN, 2009g).

- **HAPC –** HAPC is defined as special designations of EFH. These designations encompass a variety of species and habitats, including pelagic *Sargassum*; SAV; mangroves; hermatypic coral habitats and reefs; coastal inlets; state-designated nursery areas; state-designated overwintering areas; live/hard bottom used as spawning habitat for members of the snapper-grouper complex; oyster/shell habitat; and nearshore (< 4 m [13 ft] deep) hard bottom habitat. Designation of HAPC may vary, depending on the particular FMC. Some councils specify individual or specific habitats while others designate broad geographic areas. Some councils designate HAPC for all managed species, while others designate HAPC for particular species or life stages. The most common HAPC is pelagic *Sargassum*, which can occur at any given time within the range and corridor areas. Pelagic *Sargassum* is spawning habitat for coastal migratory pelagic MU species. Within Site A, designated HAPC occurs in the surface waters in areas where *Sargassum* is present and on the bottom as areas of live/hard bottom identified as snapper-grouper spawning grounds. The SAFMC proposes designating deepwater coral areas off the coasts of North Carolina, South Carolina, Georgia, and Florida, as a coral-HAPC, which is similar to an EFH-HAPC designation. The HAPCs are used by 25 species in five MUs in the range area and by 26 species in six MUs in the corridor area (DoN, 2009g).

3.2.4.2 Site B

In federal waters, the SAFMC is responsible for managing the fisheries off the South Carolina coast. In addition, some of the species found off South Carolina are covered by the MAFMC, which co-manages the spiny dogfish with the NEFMC.

For Site B, the SAFMC and NMFS maintain FMPs for nine MUs and seven MUs, respectively, as described for Site A (SAFMC, 1998a, b; NMFS, 2006b). In the Charleston OPAREA, the MAFMC maintains FMPs for three MUs (summer flounder, scup, and black sea bass; bluefish; and spiny dogfish) (MAFMC, 1998a). As previously discussed, eight MPAs have recently been designated by the SAFMC's as part of the South Atlantic snapper-grouper FMP. The designated Charleston Deep Artificial Reef MPA is located in Site B (Figure 3.2-3). 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).

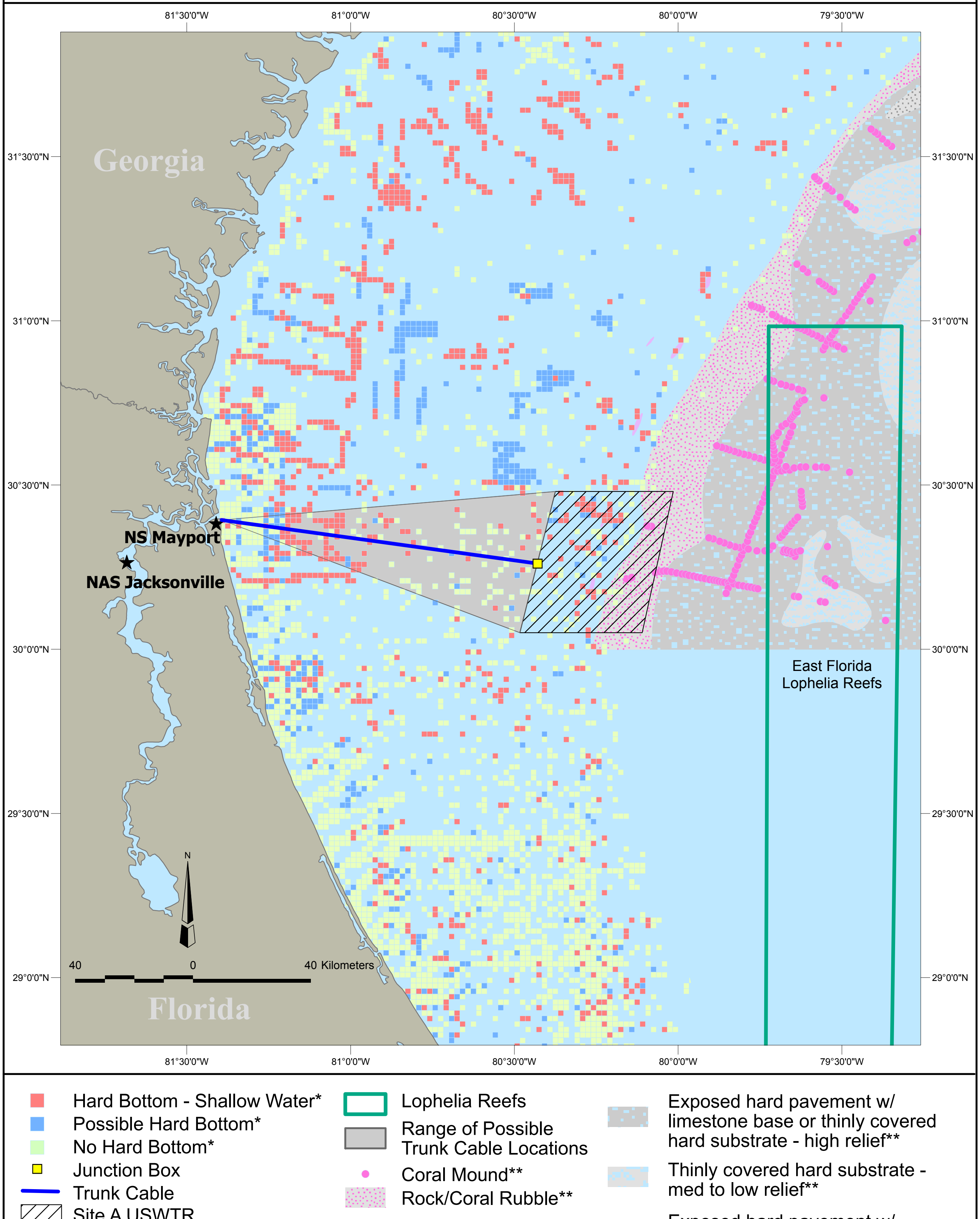
There are eight marine EFHs found within the Site B area, including the USWTR range (1,471 km^2 [428 NM^2]) and the corridor that connects the range with the shore facility (corridor) (1,217 km^2 [354 NM^2]) (NOAA, 1999; NMFS, 2002a, b; DoN, 2009g): benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, currents, nearshore habitats, and HAPCs.

- **Benthic substrates (not including live/hard bottom) –** The benthic substrate found in Site B is composed primarily of quartzite or calcium carbonate (25 to 75 percent) sand or thin layers of fine-grained sand and silt (Amato, 1994; USGS, 2000). Within Site B, benthic substrates (not including live/hard bottom) comprise 87 percent of the range (1,285 km^2 [375 NM^2]) and 78 percent of the corridor (947 km^2 [276 NM^2]). Within the range and corridor, 23 species in nine MUs and 18 species in five MUs, respectively use these types of benthic substrates (DoN, 2009g).

- **Live/hard bottom –** Nearshore and offshore live/hard bottom communities in the region of Site B (Figure 3.2-4) are typically developed by benthic organisms including sponges, bivalves, hydroids, amphipod tubes, red algae, bryozoans, anthozoans, and macroalgae. Areas of live/hard bottom comprise habitat for various warm-temperate and tropical species of the snapper-grouper complex and associated fishes. Many adult members of the snapper-grouper MU use these offshore live/hard bottom habitats (NEFMC, 1998; SAFMC, 1998a).

  Live/hard bottom communities in Site B are found on a Holocene rock-ridge system that extends along the shelf break (Kirby-Smith, 1989; ASMFC, 2001). The rock-ridge system is composed of consolidated sediments, limestone algae, and sandstone (Kirby-Smith, 1989; ASMFC, 2001). Part of the seafloor of the Site B range is a relict rock ridge that extends along the shelf break from Cape Hatteras, North Carolina, south to Florida; this rock ridge is encrusted with fauna

Biogenic Reef Community Data for Site A

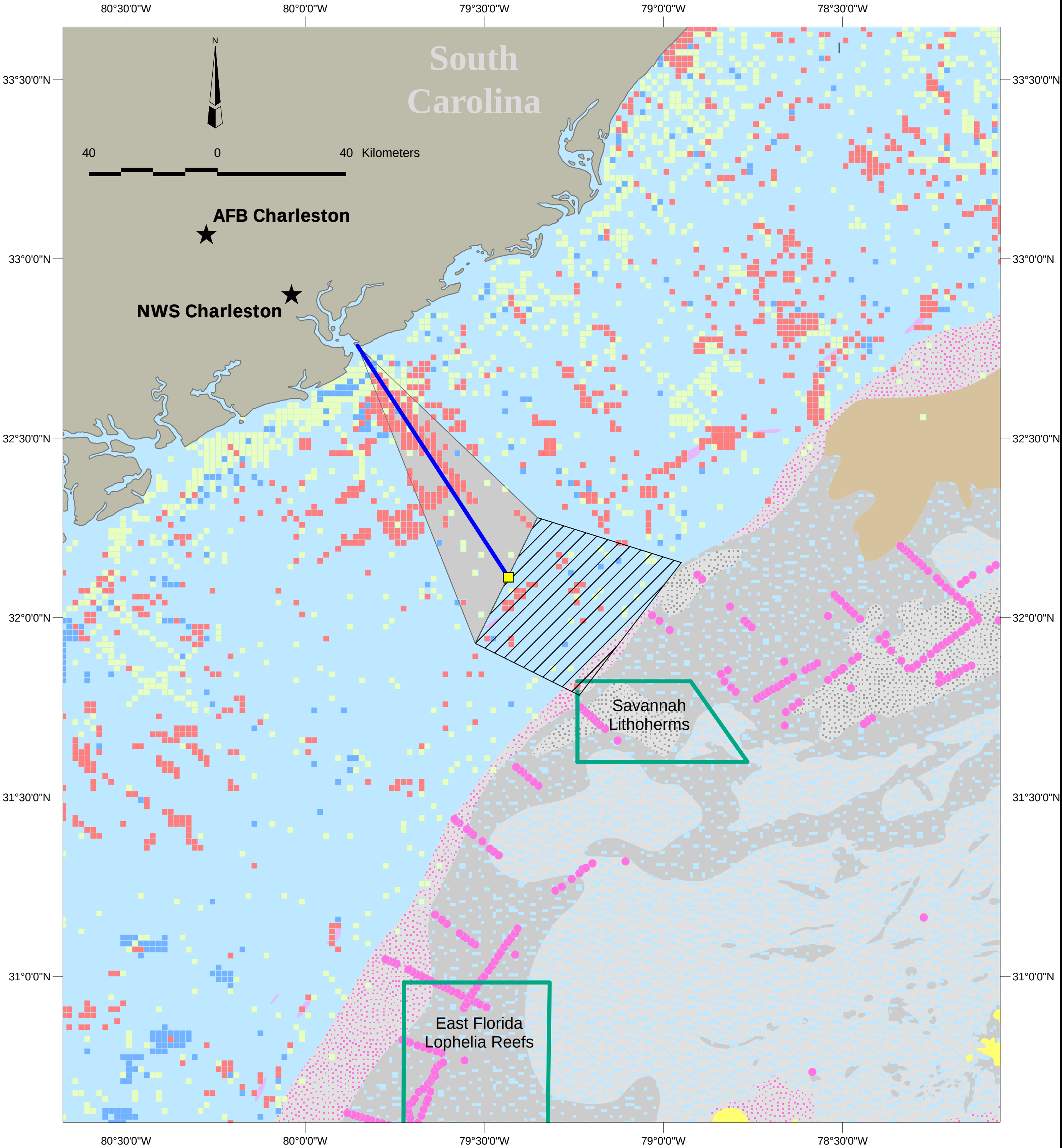


* Bottom type data from SEAMAP CD-ROM version 1.2 and data compiled by Florida Marine Research Institute, 1998

** FWC-FWRI Final Habitat Plan for the South Atlantic Region, October 1998

Figure 3.2-3

Biogenic Reef Community Data for Site B



Hard Bottom - Shallow Water*
Possible Hard Bottom*
No Hard Bottom*
Junction Box
Trunk Cable
Site B USWTR
Lophelia Reefs
Range of Possible Trunk Cable Locations
Coral Mound**
Rock/Coral Rubble**
Unconsolidated Sand**
Exposed hard pavement w/ limestone base or thinly covered hard substrate - high relief**
Thinly covered hard substrate - medium to low relief**
Exposed hard pavement w/ siltstone base**
Exposed hard pavement**

* Bottom type data from SEAMAP CD-ROM version 1.2 and data compiled by Florida Marine Research Institute, 1998

** FWC-FWRI Final Habitat Plan for the South Atlantic Region, October 1998.

Figure 3.2-4

and flora. Although Site B may contain isolated coral patches or mounds (DeVictor and Morton, 2007), there are no true coral reefs similar in size, structure, or composition to those found in the Caribbean.

Within Site B, areas of known live/hard bottom comprise about 13 percent (186 km^2 [54 NM^2]) of the range and 22 percent (270 km^2 [79 NM^2]) of the corridor (SAFMC 2001, 2007). Nineteen species in six MUs use the live/hard bottom habitat of the range, while 15 species in four MUs utilize the corridor's live/hard bottom habitat (DoN, 2009g).

Within the range, outer shelf live/hard bottom supports hard and soft corals, sponges, bryozoans, and numerous snapper-grouper MU species (BLM, 1978; NOAA, 2005). The Savannah lithoherms, a type of deepwater reef, consist of dense mounds of the reef-building corals *Lophelia pertusa* and *Enallopsammia profunda* (Reed et al., 2006). They are located in the southeastern portion of Site B; 167 km (90 NM) off the coast of Savannah, Georgia, along the western edge of the Blake Plateau in water depths of 490 to 550 m (1,608 to 1,805 ft) (Reed and Ross, 2005; Reed et al., 2006). The *L. pertusa* mounds reach 30 to 60 m (98 to 197 ft) in height and occur along the Florida-Hatteras slope on the Charleston Bump (450 to 850 m [1,476 to 2,789 ft]) (Reed et al., 2006). The north faces of the lithoherms have exposed black phosphoritic pavements that support coral mounds. The mounds have a NNE-SSW orientation, are 10 m (33 ft) in height, average 1 km (3,281 ft) in length, and have 25° to 37° slopes (Reed et al., 2006). In addition to *L. pertusa* there are other coral and sponge species (10 percent of the total live coverage) found on the north faces of the high relief mounds such as black coral (*Antipathes* sp.), octocorals (gorgonians), and numerous species of sponges (fan sponges [*Phakellia* sp.], and glass sponges [Hexactinellida]) (Reed et al., 2006). The south slopes of the lithoherms have less of a slope (10°) and 90 percent of their substrate consists dead of *L. pertusa* and coarse sand (Reed et al., 2006).

The SAFMC has developed strategies and plans to protect deep sea coral and sponge habitat. For example, the proposed Charleston Deep Artificial Reef MPA located in Site B would prohibit bottom fishing gear and anchoring in this area (SAFMC, 2007c). Site B corals are also protected under the SAFMC FMP for coral. The FMP prohibits the harvest of stony corals, sea fans, coral reefs, and live rock except as authorized for scientific and educational purposes (SAFMC, 2006).

Within the corridor area, there are isolated coral patches or mound reefs that grow on the top of exposed live/hard bottom consisting of temperate hard corals (*Oculina arbuscula*), soft corals, invertebrates, amphipods, and many commercial and recreational fish species (DeVictor and Morton, 2007).

- **Artificial/manmade reefs –** Artificial/manmade reefs identified as EFH are found throughout the Charleston OPAREA. While there are no artificial reefs in the range, there are three artificial reef complexes in the corridor (SCDNR, 2006). Four species from four MUs use the artificial/manmade reef EFH in the corridor area (SAFMC, 1998a; DoN, 2009g).

- **Pelagic *Sargassum*** – The presence of pelagic *Sargassum* within Site B is transient and is dependent on prevailing surface currents (occasional mats of *Sargassum* may float through the area). Within Site B, pelagic *Sargassum* habitat has the potential to occur at any given time. The pelagic *Sargassum* EFH supports 20 fish and invertebrate species in two MUs in the range and 19 species in three MUs in the corridor (DoN, 2009g).

- **Water column –** Within Site B, the EFH-designated water column habitat overlies 100 percent of the range (1,471 km^2 [428 NM^2]) and 100 percent of the corridor (1,217 km^2 [354 NM^2]). The water column EFH supports 38 species in 15 MUs in the range and 38 species in 11 MUs in the corridor (DoN, 2009g).

- **Currents –** In the Site B range, the entire range (716 km^2 [208 NM^2]) and 74 percent (898 km^2 [262 NM^2]) of the corridor is designated as currents EFH due to the presence of the Gulf Stream. A total 31 species in ten MUs use currents as EFH (DoN, 2009g).

- **Nearshore** – There are no nearshore habitats in the Site B range. In the Site B corridor, nearshore EFH consists of estuaries, coastal embayments, wetlands, water column, oyster reefs, SAV, and other hard and soft benthic substrates (SAFMC, 1998a) and comprises 8.4 km^2 (2.4 NM^2) or about 0.69 percent of the total corridor area. Nearshore EFH supports 42 species in 13 MUs (DoN, 2009g).

- **HAPC –** Within Site B, the HAPC consist of pelagic *Sargassum* (which has the potential to occur anywhere within the range and corridor but has a patchy distribution), coral and live/hard bottom (important to species of the snapper-grouper complex for spawning), oyster habitat, and nearshore habitats (SAV, coastal inlets, mangroves, etc.). The SAFMC proposes designating deepwater coral areas off the coasts of North Carolina, South Carolina, Georgia, and Florida, as a coral-HAPC, which is similar to an EFH-HAPC designation. Seventy-nine point source location (e.g., reefs) HAPC occur in the range and 23 occur in the corridor at Site B. The HAPC support 25 species in seven MUs in the range and 26 species in six MUs in the corridor (DoN, 2009g).

3.2.4.3 Site C

In federal waters, the SAFMC and the MAFMC are responsible for managing fisheries off the North Carolina coast. In addition, some of the species found off North Carolina are covered by the NEFMC, which co-manages the monkfish and the spiny dogfish with the MAFMC.

For Site C, the SAFMC and NMFS maintain FMPs for nine MUs and seven MUs, respectively, as cited for Site A (see Subchapter 3.2.4.1) (SAFMC, 1998a, b; NMFS, 2006b). In the Cherry Point OPAREA, the MAFMC maintains FMPs for six MUs (summer flounder, scup, and black sea bass; bluefish; tilefish; Atlantic surfclam and ocean quahog; Atlantic mackerel, squid, and butterfish; and spiny dogfish), and the NEFMC maintains FMPs for four MUs (deep-sea red crab; northeast multispecies; northeast skate complex; and monkfish) (MAFMC, 1998a; NEFMC, 1998).

Eight types of marine EFHs are found within the Site C area, including the USWTR range (1,639 km^2 [478 NM^2]) and the corridor that connects the range with the shore facility (corridor) (1,835 km^2 [535 NM^2]) (NOAA, 1999; NMFS, 2002a, b): benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, currents, nearshore habitats, and HAPCs.

- **Benthic substrates (not including live/hard bottom) –** The benthic substrate (not including live/hard bottom) found in Site C is composed primarily of quartzite or calcium carbonate (25 to 75 percent) sand or thin layers of fine-grained sand and silt (Hollister, 1973; Amato, 1994; USGS, 2000; Street et al., 2005). Within Site C, EFH-designated benthic substrates comprise 94 percent of the range (1,534 km^2 [447 NM^2]) and 89 percent of the corridor (1,637 km^2 [477 NM^2]). The benthic substrates EFH supports 22 species in 10 MUs in the range area (DoN, 2009g) and 20 species in 9 MUs in the corridor area (DoN, 2009g).

- **Live/hard bottom –** Nearshore and offshore live/hard bottom communities in the Site C area are typically developed by benthic organisms, including sponges, bivalves, hydroids, amphipod tubes, red algae, bryozoans, anthozoans, and macroalgae. These communities in the training range of Site C are found on a Holocene rock-ridge system that extends along the shelf break (Kirby-Smith, 1989; ASMFC, 2001). The rock-ridge system is composed of consolidated sediments, limestone algae, and sandstone (Kirby-Smith, 1989; ASMFC, 2001). Part of the seafloor of the Site C range is a relict rock ridge that extends along the shelf break from Cape Hatteras, North Carolina, south to Florida; it is encrusted with fauna and flora.

  Within Site C, live/hard bottom EFH comprises six percent of the range (105 km^2 [31 NM^2]) and 11 percent of the corridor area (204 km^2 [59 NM^2]) (Figure 3.2-5). Live/hard bottom in Site C supports 11 species in three MUs in the range area and nine species in three MUs in the corridor area (DoN, 2009g).

Within the range area, outer shelf reefs support hard and soft corals, sponges, bryozoans, and numerous snapper-grouper MU species (BLM, 1978; NOAA, 2005). Two deepwater coral reefs known as the *Lophelia* banks are located on top of the ridge system extending along the shelf break at water depths between 200 and 1,000 m (656 and 3,280 ft) (Stetson et al., 1962; S. Ross, 2004; NOAA, 2005, 2006a). The northernmost area contains the most extensive coral mounds off North Carolina (SAFMC, 2007a). The main mound system rises vertically nearly 80 m (262 ft) over a distance of about one kilometer (0.5 NM). Sides and tops of these mounds are covered extensively with two types of deep water corals, *Lophelia pertusa* and *Madrepora oculata*. The second area contains mounds that rise at least 53 m (174 ft) over a distance of about 0.4 km (0.2 NM). The SAFMC has developed strategies and plans to protect deep sea coral and sponge habitat. For example, there is a proposed HAPC site for the Cape Lookout *Lophelia* banks located in Site C, which would prohibit bottom fishing gear and anchoring (SAFMC, 2007b). Site corals are also protected under the SAFMC FMP for coral that prohibits the harvest of stony corals, sea fans, coral reefs, and live rock except as authorized for scientific and educational purposes (SAFMC, 2006).

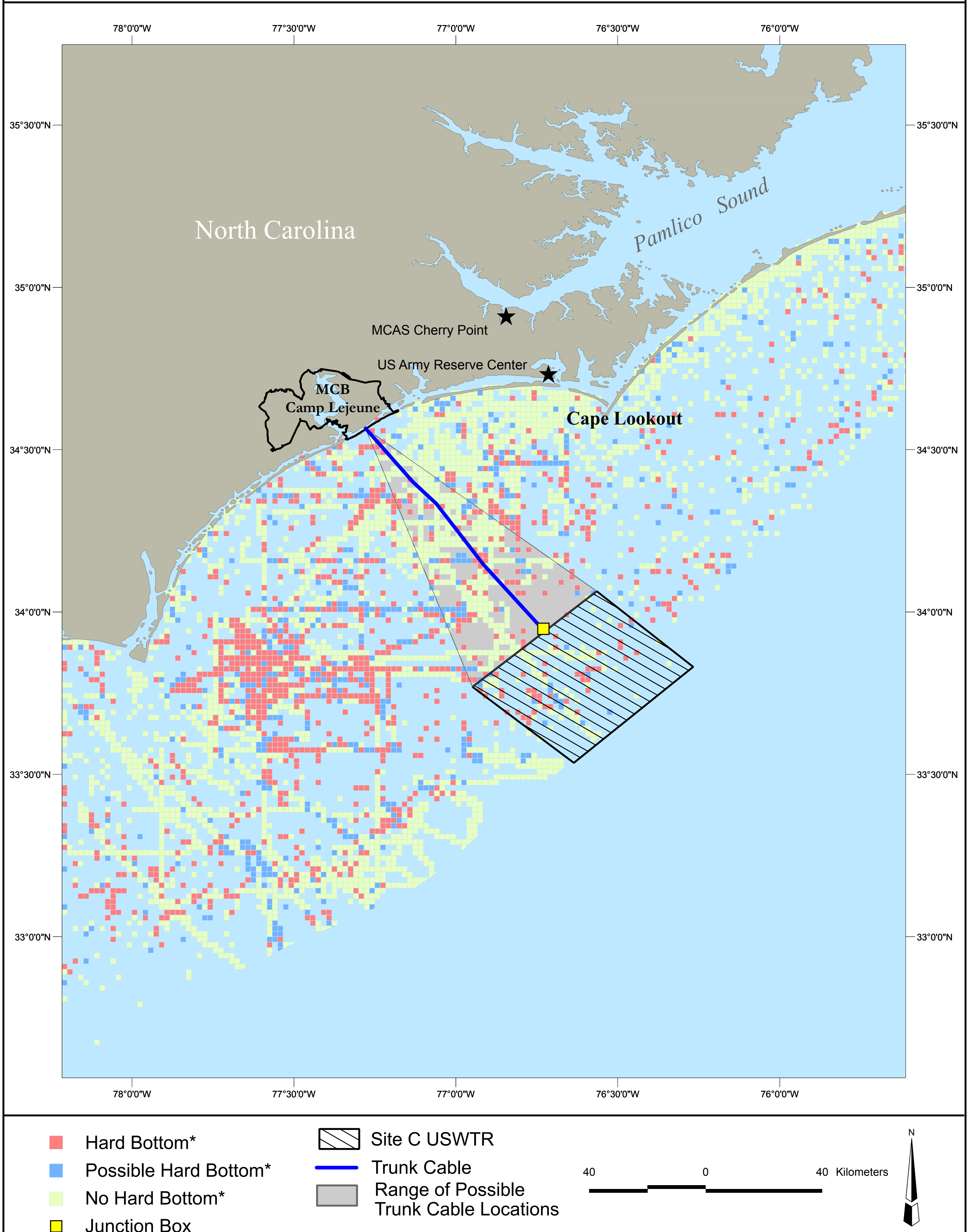
Within the corridor area, there are reefs that grow on the top of exposed live/hard bottom that consist of temperate hard corals (*Oculina arbuscula*), soft corals, invertebrates, amphipods, and many commercial and recreational fish species (Huntsman and Macintyre, 1971; NCDMF, 2005a).

- **Artificial/manmade reefs** – Artificial reefs identified as EFH are found throughout the Cherry Point OPAREA. There are ten artificial reefs located in the range area and 30 reef complexes that encompass more than 100 reef sites in the corridor area. Artificial reefs serve as an EFH to four species in two MUs in the range area and four species in one MU in the corridor area (DoN, 2009g).

- **Pelagic *Sargassum* habitat** – Occasional pelagic mats of *Sargassum* may float through Site C, yet their presence within the area is transient and dependent on prevailing surface currents. Casazza and Ross (2008) reported at least 80 species of fish under *Sargassum* weedlines off Cape Hatteras, North Carolina. Within Site C, pelagic *Sargassum* habitat has the potential to occur throughout the range area and corridor areas at any given time. The pelagic *Sargassum* EFH supports 17 species in three MUs in the range area and 18 species in two MUs in the corridor areas (DoN, 2009g).

- **Water column** – Within Site C, the EFH-designated water column habitat comprises 100 percent of the range area (1,639 km^2 [478 NM^2]) and 100 percent of the corridor area (1,835 km^2 [535 NM^2]). The water column EFH supports 40 species in 15 MUs in the range area and 38 species in 13 MUs in the corridor area (DoN, 2009g).

Biogenic Reef Community Data for Site C



* Bottom type data from SEAMAP CD-ROM version 1.2

Figure 3.2-5

- **Currents** – The entire 1,639 km^2 (478 NM^2) of the range is designated as current EFH. In addition, 92 percent (1,691 km^2 [262 NM^2]) of the corridor closest to the range is also considered current EFH. A total 29 species in 10 MUs in the range and corridor use currents as EFH (DoN, 2009g).

- **Nearshore** – There are no nearshore habitats in the Site C range. In the Site C corridor nearshore EFH consists of estuaries, coastal embayments, wetlands, water column, oyster reefs, and hard bottom (Street et al., 2005) and comprises 6.9 km^2 (3.7 NM^2) or about 0.4 percent of the overall corridor. Nearshore EFH of the corridor supports 39 species in 14 MUs (DoN, 2009g).

- **HAPC –** Within Site C, HAPC consists primarily of pelagic *Sargassum*, which has the potential to occur anywhere within the range and corridor but has a patchy distribution, live/hard bottom identified as spawning grounds for species in the snapper-grouper complex, oyster habitat, and nearshore habitats (SAV, coastal inlets, mangroves, etc). The SAFMC proposes designating deepwater coral areas off the coasts of North Carolina, South Carolina, Georgia, and Florida, as a coral-HAPC, which is similar to an EFH-HAPC designation. Twelve point source location (e.g., spawning grounds) HAPC occur in the range and 15 occur in the corridor at Site C. The HAPC supports 25 species in four MUs in the range area and 30 species in seven MUs in the corridor area (DoN, 2009g).

3.2.4.4 Site D

The MAFMC is responsible for the management of fisheries in federal waters off the mid-Atlantic Coast, including Virginia. FMPs maintained by the MAFMC and NMFS for MUs relevant to Site D pertain to the same six and seven MUs, respectively, cited for Site C in Subchapter 3.2.4.3 (MAFMC, 1998a; NMFS, 2006a). The NEFMC maintains FMPs for six MUs in the VACAPES OPAREA: Atlantic herring, Atlantic sea scallop, deep-sea red crab, northeast multispecies, northeast skate complex, and monkfish (NEFMC, 1998).

The MAFMC and NMFS have identified eight marine/offshore EFHs for the Site D range (1,591 km^2 [464 NM^2]) and corridor (1,480 km^2 [431 NM^2]) (NOAA, 1999; NMFS, 2002a, b): benthic substrate, live/hard bottom, artificial/manmade reefs, pelagic *Sargassum*, the water column, nearshore habitat, and HAPCs. The range and corridor areas of Site D are west of the Gulf Stream; therefore current EFH is outside of the study area and no current EFH is located within Site D.

- **Benthic substrates (not including live/hard bottom) –** Most benthic substrates in the range originated from rivers, glaciers, terrigenous and submarine outcrops of older rocks, and biogenic productivity (Tucholke, 1987). Due to the high-energy current and tidal systems that pass over the shelf in the range, sediments are swept off the shelf into deeper water (Riggs et al., 1998). The sediments on the shelf within the range consist mostly of quartz and feldspar and increase in grain size closer to the shelf break (Hollister, 1973; Tucholke, 1987; USGS, 2000). In addition, there is very little calcium carbonate (five percent) mixed in with the sand on the shelf, which distinguishes Site D from the other sites located farther south.

In the range and on the slope, there is an accumulation of silty clay (Tucholke, 1987). Soft benthic substrates within the corridor are composed of the same soft substrates that occur in the range but have greater amounts of finer grained silts and clays (e.g., shoals) deposited from tidal currents (Hollister, 1973; Tucholke, 1987; USGS, 2000). Overall, the benthic soft sediments of the corridor are finer closer to shore, primarily due to erosion and suspension induced by the Gulf Stream, as well as storms that distribute and resuspend bottom sediments (Tucholke, 1987). Within Site D, benthic substrates (not including live/hard bottom) comprise 100 percent of the seafloor in the range (1,591 km^2 or 464 NM^2) and 100 percent of the seafloor in the corridor (1,480 km^2 or 431 NM^2). The benthic substrates support 26 species in 12 MUs in the range area and 19 species in nine MUs in the corridor area (DoN, 2009g).

- **Live/Hard bottom –** Live/hard bottom EFH in the range and corridor areas exists only in the form of shipwrecks, which are considered by the MAFMC to be EFH. Details on the extent or locations of natural live/hard bottom are unavailable (Amato, 1994; USGS, 2000; NAVOCEANO, 2006b; MAFMC, 1998b; Hoff, 2006). The EFH-designated hard bottom is used by 12 species in 8 MUs in the range and 7 species in 6 MUs in the corridor (DoN, 2009g).

- **Artificial/Manmade Reefs –** Within Site D, there are no dedicated artificial or manmade reefs in the range, but there are five are found in the corridor. The Virginia Marine Resources Commission (VMRC) maintains the artificial reef program in Virginia waterways. The five artificial reefs in the corridor are composed of various materials such as railway cars and military vehicles. Artificial reefs in this region on the continental shelf attract numerous commercially important fish species because of the relatively featureless topography in this area (Steimle and Zetlin, 2000). The artificial reefs designated as EFH support one species in one MU (DoN, 2009g).

- **Pelagic *Sargassum* –** *Sargassum* may occur throughout the entire range but is not always present since its distribution is dependent on currents. Within Site D, pelagic *Sargassum* has the potential to occur in the range and the corridor (1,480 km^2 [431 NM^2]) at any given time. The EFH-designated pelagic *Sargassum* may support three species in one MU in both the range and corridor area (DoN, 2009g).

- **Water Column –** Within Site D, the EFH-designated water column comprises 100 percent of the range (1,591 km^2 or 464 NM^2) and 100 percent of the corridor

(1,480 km^2 or 431 NM^2). The water column can support 38 species in 16 MUs in the range area and 28 species in 15 MUs in the corridor area (DoN, 2009g).

- **Nearshore Habitat EFH –** There is no nearshore habitat designated as EFH in the range area. The nearshore habitat in the corridor consists of coastal bays and wetlands that support abundant juvenile fish and shellfish (Wazniak et al., 2004; MDDNR, 2006). Chincoteague Bay is located along the eastern shore of Virginia and Maryland within the Assateague barrier island chain and supports numerous seagrass beds, salt marshes, and wetlands, which shelter various life stages of fish and shellfish species (Wazniak et al., 2004). Three percent of the corridor area (51 km^2 [27 NM^2]) is designated as nearshore EFH and supports 26 species of fish and invertebrates in 14 MUs (DoN, 2009g).

- **HAPC –** Surface waters of the range and the corridor are designated as HAPC and can occur anywhere in the range because of the potential for the presence of pelagic *Sargassum*. Three species of fish and invertebrates in one MU utilize the range as HAPC (DoN, 2009g). In addition, five species of fish and invertebrates in three MUs utilize the corridor as HAPC (DoN, 2009g).

3.2.5 Sea Turtles

Five species of sea turtles occur in the Atlantic coastal waters off the eastern U.S., including the continental shelf and shelf-break regions. All five are listed as threatened or endangered (as shown in Table 3.2-2). Extralimital occurrences of the olive ridley turtle (*Lepidochelys olivacea*) are possible but not likely, as they occur south of Florida in the Southern Atlantic Ocean (Foley et al., 2003; Stokes and Epperly, 2006), and, thus, this species is not discussed further here.

NMFS and USFWS share jurisdictional responsibility for sea turtles under the ESA. USFWS has responsibility in the terrestrial environment while NMFS has responsibility in the marine environment. USFWS jurisdiction on terrestrial environments applies during the nesting stage of the sea turtles' life cycle and on any beach habitat where regulatory and conservation measures apply, while NMFS jurisdiction applies when the sea turtles are in the water.

Along the U.S. Atlantic coast, four sea turtle species (leatherback, loggerhead, Kemp's ridley and green) migrate seasonally from offshore and warmer southern waters far into northern latitudes each summer (Morreale, 2005). Nesting is also documented for beaches bordering the region.

Table 3.2-2

Sea Turtles Found in the JAX, CHASN, CHPT, and VACAPES OPAREAs

Species	Scientific Name	Status
Hawksbill	*Eretmochelys imbricata*	Endangered
Leatherback	*Dermochelys coriacea*	Endangered
Green	*Chelonia mydas*	Endangered [1]
Loggerhead	*Caretta caretta*	Threatened
Kemp's ridley	*Lepidochelys kempi*	Endangered
Note: [1]Green sea turtles are listed as threatened; however, the Florida and Mexican Pacific coast nesting populations are listed as endangered. There is the potential for green sea turtles from the endangered Florida population to be found in the JAX, CHASN, CHPT, and VACAPES OPAREAs.		

Off the U.S. Atlantic Coast, sea turtle distribution in temperate waters generally shifts on a seasonal basis in response to changes in water temperature and prey availability (Lutcavage and Musick, 1985; Musick and Limpus, 1997; Coles and Musick, 2000). During winter months, sea turtle distribution shifts either south or offshore, where water temperatures are warmer and prey is more abundant (e.g., Epperly et al., 1995a, b, c). Throughout the rest of the year, sea turtles are common residents of inshore and nearshore waters along the U.S. Atlantic Coast as far north as Massachusetts.

3.2.5.1 Site A

Large numbers of juvenile sea turtles use the many lagoons, estuaries, bays, and offshore reefs of the southeast U.S. coast as both foraging and resting habitats. In addition, the waters of the Jacksonville OPAREA provide suitable habitat for mature females that travel long distances to nest on the region's ocean-facing beaches. As a region, the southeast U.S. has the most diverse and abundant sea turtle populations in the entire U.S.

Loggerhead Turtle – Site A

- **General Description—**The loggerhead turtle is a large hard-shelled sea turtle that is named for its disproportionately large head. The average straight carapace length (SCL) of an adult female loggerhead is between 90 and 95 cm (3.0 and 3.1 ft) and the average weight is 100 to 150 kg (220 to 330 lbs) (C. Dodd, 1988). Adults are mainly reddish-brown in color on top and yellowish underneath.

  The diet of loggerhead turtles changes with age and size (e.g., Godley et al., 1998). The gut contents of post-hatchlings found in masses of *Sargassum* contained parts of *Sargassum*, zooplankton, jellyfish, larval shrimp and crabs, and gastropods (Carr and Meylan, 1980; Richardson and McGillivary, 1991; Witherington, 1994). Juvenile and subadult loggerhead turtles are omnivorous, foraging on pelagic crabs, mollusks, jellyfish, and vegetation captured at or near the surface (C. Dodd, 1988; Frick et al., 1999). Adult loggerheads are carnivorous, often foraging on fish in nearshore waters, as well as benthic invertebrates (mollusks, crustaceans, and coelenterates) (C. Dodd, 1988).

On average, loggerheads spend over 90 percent of their time underwater (Byles, 1988; Renaud and Carpenter, 1994; Narazaki et al., 2006). Loggerheads tend to remain at depths shallower than 100 m (328 ft) (e.g., Houghton et al., 2002; Polovina et al., 2003; Hawkes et al., 2006; Narazaki et al., 2006; McClellan et al., 2007). Routine dive depths are typically shallower than 30 m (98 ft) (Houghton et al., 2002), although dives of up to 233 m (764 ft) have been recorded for a post-nesting female loggerhead off Japan (Sakamoto et al., 1990). During routine activities, dives typically can last from 4 to 120 minutes (min) (Byles, 1988; Sakamoto et al., 1990; Renaud and Carpenter, 1994; Bentivegna et al., 2003; C. Dodd and Byles, 2003).

- **Status—**Loggerhead turtles are listed as threatened under the ESA. The loggerhead is the most abundant sea turtle occurring in U.S. waters. In the continental U.S. there are four demographically independent loggerhead nesting groups or subpopulations: (1) Northern: North Carolina, South Carolina, Georgia, and northeast Florida; (2) South Florida: occurring from 29°N on the east coast to Sarasota on the west coast; (3) Florida Panhandle: Eglin Air Force Base and the beaches near Panama City, and (4) Dry Tortugas (Witherington et al., 2006). Bowen et al. (1995) noted that under a conventional interpretation of the nuclear deoxyribonucleic acid (DNA) data, all breeding populations in the entire southeastern U.S. would be regarded as a single management unit, yet the mitochondrial DNA data indicate multiple isolated populations, and further suggest this complex population structure mandates a different management strategy at each life stage. The South Florida nesting subpopulation is the largest loggerhead rookery in the Atlantic Ocean (and the second largest in the world), followed by the Northern, the Florida Panhandle, and the Dry Tortugas subpopulations (Ehrhart et al., 2003; Witherington et al., 2006). The south Florida nesting subpopulation produced between 43,500 and 83,400 nests annually over the past decade (USFWS and NMFS, 2003). Nesting trends indicate that the number of nesting females associated with the south Florida subpopulation is increasing (Epperly et al., 2001). The south Florida subpopulation also contributes significantly to loggerheads off the Carolinas (66 percent) and in North Carolina's Albemarle-Pamlico Estuarine Complex (Epperly et al., 2001).

- **Habitat—**The loggerhead turtle occurs worldwide in habitats ranging from coastal estuaries to waters far beyond the continental shelf (C. Dodd, 1988). The species may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Results from tagging data of juvenile loggerheads in both the eastern and western North Atlantic suggest that the location of currents and associated frontal eddies is important to the foraging ecology of the pelagic stage of this species (McClellan et al., 2007). The neritic juvenile stage and adult foraging stage both occur in the neritic zone (shallow water, or nearshore marine zone extending from the low-tide level to a depth of 200 m [656 ft]).

Coral reefs, rocky places, and shipwrecks are often used as feeding areas. The turtles in these areas feed primarily on the bottom (epibenthic/demersal), though prey is also captured throughout the water column (Bjorndal, 2003; Bolten, 2003). The neritic zone not only provides crucial foraging habitat but can also provide inter-nesting and overwintering habitat. Satellite telemetry data from tagged nesting females has revealed that post-nesting migratory routes can be highly variable from one individual to another; ranging from coastal to deep oceanic waters (Schroeder et al., 2003).

- **General Distribution—**Loggerhead turtles are widely distributed in subtropical and temperate waters (C. Dodd, 1988). Loggerhead turtles can be found along the U.S. Atlantic coast from Cape Cod to the Florida Keys during any season. Loggerheads seem generally restricted to waters of the North Atlantic Ocean south of 38°N, with mean SSTs around 22°C (72°F). In the MAB, loggerheads concentrate in continental shelf waters but are also commonly sighted in deeper, offshore waters (Shoop and Kenney, 1992). A pattern of a higher proportion of small and apparently young individuals has been noted along a northward gradient in loggerheads, green turtles, and particularly in Kemp's ridleys (Morreale and Standora, 2005). In North Carolina and Virginia, the proportion of breeding adult loggerheads in bays and estuaries is smaller than in Georgia and Florida, with most individuals classified as medium-sized juveniles.

Low water temperatures affect loggerhead turtle activity and cold-stunned (severe hypothermia) loggerheads have been found in various locales, including off the northeastern U.S. (Morreale et al., 1992). Immature loggerheads inhabiting cool-temperate areas in the western North Atlantic usually migrate seasonally to avoid cold-stunning (Musick and Limpus, 1997). Some loggerheads are believed to escape cold conditions by burying themselves in the bottom sediment and hibernating (Carr et al., 1980; Ogren and McVea, 1995; Hochscheid et al., 2005). In early spring, juvenile loggerheads over-wintering in southeastern U.S. waters begin to migrate north to developmental feeding habitats (Morreale and Standora, 2005).

The generally accepted life-history model for the species has been summarized by Musick and Limpus (1997), Bolten (2003), and Hawkes et al. (2006). Hatchlings travel to oceanic habitats, often occurring in *Sargassum* drift lines (Carr, 1986, 1987b; Witherington and Hirama, 2006). When juveniles reach sizes between 40 and 60 cm (1.3 to 2.0 ft) in carapace length (about 14 years old) some individuals begin to recruit to the neritic zone (benthic habitat in shallow coastal waters) close to their natal area, while others remain in the oceanic habitat or move back and forth between the two (e.g., Musick and Limpus, 1997; Laurent et al., 1998). Turtles either may utilize the same neritic developmental habitat all through maturation, or they may move among different areas and finally settle in an adult foraging habitat. At sexual maturity (about 30 yrs old), adults switch from subadult to adult neritic foraging habitats (Musick and Limpus, 1997; Godley et al., 2003).

In direct contrast with the accepted life-history model for this species, Hawkes et al. (2006) recently reported that tagging work at the Cape Verde Islands (Africa) revealed two distinct adult foraging strategies that appear to be linked to body size. The larger turtles foraged in coastal waters, whereas smaller individuals foraged oceanically. Likewise, off Japan, epipelagic foraging has been recorded for adult female loggerheads (Hatase et al., 2002). Hawkes et al. (2006) also found that movements of adult loggerheads off Cape Verde were in part driven by local surface currents, with active movement by individuals to remain in areas of high productivity.

<u>Occurrence in the Proposed Site A USWTR</u>—Loggerheads are expected to occur year-round within the Site A USWTR. They are the most common sea turtle species present in the Jacksonville OPAREA and occur year-round, using the waters for overwintering, foraging, migrating, and traveling to nesting beaches. Loggerheads are distributed over the continental shelf and slope, with the majority found between the shoreline and the shelf break. Significant populations are known to occur in the following areas: Cape Fear River, North Carolina; Charleston Harbor, South Carolina; Port of Savannah, Georgia; and the Cape Canaveral Ship Channel, Florida. Juveniles and subadults constitute more than 80 percent of loggerheads encountered in these areas from August through March (Henwood, 1987). Nesting begins in early May and lasts through early September. After an approximate two-month incubation period, eggs hatch between late June and mid-November (FFWCC, 2002). Nesting occurs along almost the entire coastline adjacent to the Jacksonville OPAREA; several of the locations are high-density nesting beaches (DoN, 2008n).

Surveys conducted in 2006 identified 103 loggerhead nests along Duval County beaches (FFWCC-FWRI, 2006a). Loggerheads have nested and continue to nest at NAVSTA Mayport beaches. Surveys began in 1998 with two nests recorded and have since indicated that the numbers have grown to 21 nests and 1,177 hatchlings in 2006, which is the largest number on record at the station (DoN, 2007g).

Leatherback Turtle – Site A

- **General Description—**The leatherback turtle is the largest living sea turtle. Mature males and females can be as long as 2 m (6.6 ft) curved carapace length (CCL) (NMFS and USFWS, 1992). Specimens less than 145 cm (4.8 ft) CCL are considered to be juveniles (NMFS-SEFSC, 2001; S. Eckert, 2002). Adult leatherbacks typically weigh between 200 and 700 kg (440 and 1,540 lbs) (NMFS and USFWS, 1992), although larger individuals have been documented (K. Eckert and Luginbuhl, 1988).

This species is placed in a separate family from all other sea turtles, in part because of their unique carapace structure. The leatherback's carapace lacks the outer layer of horny scutes possessed by all other sea turtles. It is instead composed of a flexible layer of dermal bones underlying tough, oily connective tissue and smooth skin. The body is barrel-shaped and tapered to the rear, with seven longitudinal dorsal ridges, and is almost completely black with variable spotting. All adults possess a unique pink spot on the dorsal surface of their heads, a marking used by scientists to identify specific individuals (D. McDonald and Dutton, 1996).

Leatherbacks feed throughout the epipelagic and into the mesopelagic zones of the water column (Davenport, 1988; S. Eckert et al., 1989; Grant and Ferrell, 1993; Salmon et al., 2004; James et al., 2005a). Prey is predominantly gelatinous zooplankton such as cnidarians (jellyfish and siphonophores) and tunicates (salps and pyrosomas) (NMFS and USFWS, 1992; Grant and Ferrell, 1993; Bjorndal, 1997; James and Herman, 2001; Salmon et al., 2004).

The leatherback is the deepest-diving sea turtle, with a recorded maximum dive depth of 1,230 m (4,035 ft) (Hays et al., 2004a), though most dives are much shallower than this (usually less than 200 m [656 ft]) (Hays et al., 2004a; Sale et al., 2006). Leatherbacks spend the majority of their time in the upper 65 m (213 ft) of the water column regardless of their behavior (Jonsen et al., 2007). The aerobic dive limit for the leatherback turtle is estimated to be between 33 and 67 min (e.g., Southwood et al., 1999; Hays et al., 2004b; Wallace et al., 2005). Tagging data has revealed that changes in individual turtle diving activity appear to be related to water temperature, suggesting an influence of seasonal prey availability on their diving behavior (e.g., Hays et al., 2004b). Leatherbacks dive deeper and longer in the lower latitudes versus the higher latitudes (south versus the north) (James et al., 2005a). In northern waters, they are also known to dive to waters with temperatures just above freezing (James et al., 2006; Jonsen et al., 2007). James et al. (2006) noted a considerable variability in surface time between the northern and southern latitudes. Dives in the north are punctuated by longer surface intervals (equating to much more time spent at the surface per 24-hour period), with individuals spending up to 50 percent of their time at or near the surface in northern foraging areas, perhaps in part to thermoregulate (i.e., bask).

- **Status—**Leatherback turtles are listed as endangered under the ESA. Critical habitat for leatherbacks is designated in the Caribbean at Sandy Point, St. Croix, U.S. Virgin Islands (USVI) (NMFS, 1979). All inshore and offshore waters adjacent to the U.S. Atlantic Coast between Cape Canaveral, Florida and the North Carolina-Virginia border (within the U.S. EEZ) have been designated as a "leatherback conservation zone" year-round (NOAA Fisheries, 1995).

- **Habitat—**Throughout their lives, leatherbacks are essentially oceanic, yet they enter into coastal waters for foraging and reproduction. There is limited information available regarding the habitats utilized by post-hatchling and early juvenile leatherbacks since these age classes are entirely oceanic (NMFS and USFWS, 1992). These life stages are restricted to waters warmer than 26°C (79°F) and therefore the juveniles spend much time in tropical waters (S. Eckert, 2002).

  Late juvenile and adult leatherback turtles range from the mid-ocean to the continental shelf and nearshore waters (Schroeder and Thompson, 1987; Shoop and Kenney, 1992; Grant and Ferrell, 1993; Epperly et al., 1995b). Juvenile and adult foraging habitats include both coastal areas in temperate waters and offshore areas in tropical waters (Frazier, 2001). Adults may also feed in cold waters at high latitudes (James et al., 2006). The movements of adult leatherbacks appear to be linked to the seasonal availability of their prey and reproductive cycle requirements, and may be strongly influenced by oceanic currents (Collard, 1990; Davenport and Balazs, 1991; Luschi et al., 2006).

- **General Distribution—**The leatherback turtle is distributed circumglobally in tropical, subtropical, and warm-temperate waters throughout the year and into cooler temperate waters during warmer months (NMFS and USFWS, 1992; James et al., 2005b) as far north as Nova Scotia, Newfoundland, Iceland, the British Isles, and Norway (Bleakney, 1965; Brongersma, 1972; Threlfall, 1978; Goff and Lien, 1988). The leatherback is the most oceanic and wide-ranging of sea turtles, undertaking extensive migrations along distinct depth contours for hundreds to thousands of kilometers (Morreale et al., 1996; Hughes et al., 1998). Adult leatherback turtles forage in temperate and subpolar regions in all oceans and migrate to tropical nesting beaches between 30°N and 20°S.

  According to aerial survey data, there is a northward movement of individuals along the southeast coast of the U.S. in the late winter/early spring. In February and March, most leatherbacks along the U.S. Atlantic coast are found in the waters off northeast Florida. By April and May, leatherbacks begin to occur in larger numbers off the coasts of Georgia and the Carolinas (NMFS, 1995, 2000). In late spring/early summer, leatherbacks appear off the mid-Atlantic and New England coasts, while by late summer/early fall, many will have traveled as far north as the waters off eastern Canada, remaining in the northeast from approximately May through October (CETAP, 1982; Shoop and Kenney, 1992; Wyneken et al., 2005). The location of these foraging areas changes seasonally. From March through November, foraging areas occur on the North American continental shelf and shift to off-shelf waters from December through February (S. Eckert et al., 2006).

Leatherback nesting occurs on isolated mainland beaches in tropical (mainly Atlantic and Pacific, few in Indian Ocean) and temperate oceans (southwest Indian Ocean) (NMFS and USFWS, 1992) and to a lesser degree on some islands (e.g., the Greater and Lesser Antilles). In the U.S., the densest nesting is in Florida along the Atlantic coast from Jensen Beach south to Palm Beach (Stewart and Johnson, 2006). Sporadic nesting occurs in Georgia, South Carolina, and as far north as North Carolina (Rabon et al., 2003).

Occurrence in the Proposed Site A USWTR—Leatherbacks are expected to occur year-round within the Site A USWTR. Leatherback foraging areas in the western Atlantic are located on the continental shelf (30 to 50°N) as well as offshore (42°N, 65°W) (S. Eckert et al., 2006). The location of these foraging areas changes seasonally. From March through November, foraging areas occur on the North American continental shelf yet shift to off-shelf waters from December through February (S. Eckert et al., 2006). Nesting occurs from March through July with an incubation period of 55 to 75 days (DoN, 2007g). Leatherbacks typically nest along the beaches from Brevard County south to Broward County and also nest in low numbers along the beaches of Duval County (FFWCC-FWRI, 2006b).

Green Turtle – Site A

- **General Description—**The green turtle is the largest hard-shelled sea turtle, with adults commonly reaching 1 m (3.3 ft) in carapace length and 150 kg (330 lbs) in weight (NMFS and USFWS, 1991). The adult carapace ranges in color from solid black to gray, yellow, green, and brown in muted to conspicuous patterns; the plastron is a much lighter yellow to white. The common name refers to the color of the green turtle's fat (Hirth, 1997).

  Very young green turtles are omnivorous, leaning to carnivory (Bjorndal, 1985; Bjorndal, 1997). Salmon et al. (2004) reported that posthatchling green turtles were found to feed near the surface on floating *Thalassia* and *Sargassum* or at shallow depths on ctenophores and unidentified gelatinous eggs but ignored large jellyfish (*Aurelia*) off southeastern Florida. Adult green turtles feed primarily on seagrasses (e.g., turtle grass [*Thalassia testudinum*], manatee grass [*Syringodium filliforme*], shoal grass [*Halodule wrightii*], and eelgrass [*Zostera marina*]), macroalgae, and reef-associated organisms (Burke et al., 1992; Bjorndal, 1997). They also consume jellyfish, salps, and sponges (Mortimer, 1995; Bjorndal, 1997).

  Green turtle diving behavior is likely influenced by the age class of the individual and depth of prey assemblages (Salmon et al., 2004). Adults dive deeper and slightly longer than juveniles, whose dives are generally shallow in depth (< 6 m

[(20 ft]) and shorter in duration (Salmon et al., 2004). Adult green turtles typically dive shallower than 30 m (98 ft) (Hochscheid et al., 1999; Hays et al., 2000); however, a maximum dive depth of 110 m (360 ft) was recorded (Berkson, 1967; Hochscheid et al., 1999; Hays et al., 2000). Green turtles have been known to forage and also rest at depths of 20 to 50 m (65 to 164 ft) (Balazs, 1980; Brill et al., 1995).The maximum dive time recorded for a juvenile green turtle is 66 min, with routine dives ranging from 9 to 23 min (Brill et al., 1995). Individuals may remain at the surface for longer periods of time during the winter than summer, likely due to physiological needs such as thermoregulation (Southwood et al., 2003).

- **Status—**The green turtle is classified as threatened under the ESA, with the Florida and Mexican Pacific coast nesting populations listed as endangered (NMFS and USFWS 1991d). Recent population estimates for green turtles in the western Atlantic area are not available (NMFS, 2006i).

- **Habitat—** Post-hatchling and early-juvenile green turtles reside in convergence zones in the open ocean, where they spend an undetermined amount of time in the pelagic environment (Carr, 1987a; Witherington and Hirama, 2006). Once green turtles reach a carapace length of 20 to 25 cm (7.9 to 9.8 in), they migrate to shallow nearshore areas (<50 m [164 ft] in depth) where they spend the majority of their lives as late juveniles and adults. The optimal developmental habitats for late juveniles and foraging adults are warm, shallow waters (3 to 5 m [10 to 16 ft] in depth), with an abundance of submerged aquatic vegetation, and located proximal to nearshore reefs or rocky areas, used by green turtles for resting (e.g., Holloway-Adkins and Provancha, 2005; Witherington et al., 2006).

- **General Distribution—**The green turtle has a circumglobal distribution, occurring throughout tropical and, to a lesser extent, subtropical waters (Seminoff and MTSG Green Turtle Task Force, 2004). Green turtles found in U.S. waters come from nesting beaches widely scattered throughout the Atlantic (Witherington et al., 2006). In U.S. Atlantic and Gulf of Mexico waters, greens are found around the USVI, Puerto Rico, and along the continental U.S. from Texas to Massachusetts (NMFS and USFWS, 1991). Juvenile green turtles utilize estuarine waters along the U.S. Atlantic coast as summer developmental habitat, as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds (Epperly et al., 1995a, b; Musick and Limpus, 1997). Nearshore water temperatures play a major role in determining green turtle distribution along the Atlantic and Gulf coasts of the U.S. (e.g., Musick and Limpus, 1997; Witherington et al., 2006). Adults are predominantly tropical and are only occasionally found north of southern Florida. Most sightings of individuals north of Florida occur between late spring and early fall and are juveniles (Lazell, 1980; CETAP, 1982; Burke et al., 1992; Epperly et al., 1995b).

Optimal feeding habitats for green turtles in the continental U.S. include waters in Florida and southern Texas such as the Indian River Lagoon, Florida Keys, Florida Bay, Homosassa Springs, Crystal River, Cedar Keys, and Laguna Madre Complex (NMFS and USFWS, 1991; Hirth, 1997). The inshore waters of North Carolina are also an important feeding habitat for juveniles of this species (Epperly et al., 1995b).

Green turtles nest on both island and continental beaches between 30ºN and 30ºS latitudes (Witherington et al., 2006). Although Florida is near the northern extent of the green turtle's Atlantic nesting range, it hosts a significant proportion of green turtle nesting (Witherington et al., 2006). Approximately 99 percent of the green turtle nesting in Florida occurs on the Atlantic coast, with Brevard through Broward counties hosting the greatest nesting activity (Meylan et al., 1995; Witherington et al., 2006). There are scattered nesting records in Georgia and the Carolinas (Peterson et al., 1985; Schwartz, 1989; NMFS and USFWS, 1991).

Occurrence in the Proposed Site A USWTR—Green turtles are expected to occur year-round within the Site A USWTR. Year-round resident juvenile green turtles along the Atlantic coast of Florida are found in the Indian River Lagoon as well as Florida Bay/Florida Keys south of Site A (NMFS and USFWS, 1991). During the summer months, juvenile green turtles use developmental habitats outside of the Jacksonville OPAREA and migrate through it to reach these habitats in the spring and fall. Throughout the year, green turtle occurrences in the northeastern Florida are concentrated over the continental shelf to the west of the Gulf Stream Current.

Nesting season takes place from April through September with an incubation period of approximately two months (FFWCC, 2002; DoN 2007g). Surveys conducted in 2006 identified four green turtle nests along Duval County beaches (FFWCC-FWRI, 2006a), but there are no records of them nesting at NAVSTA Mayport beaches.

Kemp's Ridley Turtle– Site A

- **General Description—** Kemp's ridleys are considered the smallest marine turtle in the world (NOAA, 2008a). This species has a straight carapace length of approximately 60 to 70 cm (2.0 to 2.3 ft) (with shell length and width being nearly equal) and weigh about 45 kg (100 lbs) (USFWS and NMFS, 1992; Gulko and Eckert, 2004). The carapace is round to somewhat heart-shaped and grayish green in color.

  Kemp's ridley turtles feed primarily on portunids and other types of crabs (Lutcavage and Musick, 1985; Keinath et al., 1987; Seney and Musick, 2005), but are also known to prey on mollusks, shrimp, fish, jellyfish, and plant material (Marquez-M., 1994; Frick et al., 1999). Kemp's ridleys may also feed on shrimp fishery bycatch (Landry and Costa, 1999).

Few data are available on the maximum dive duration. Satellite-tagged juvenile Kemp's ridley turtles demonstrate different mean surface intervals and dive depths depending on whether the individual is located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals). Dive times range from a few seconds to a maximum of 167 min, with routine dives lasting between 17 and 34 min (Mendonça and Pritchard, 1986; Renaud, 1995). In Cedar Keys, Florida, the average submergence duration was found to be approximately 8.4 min (Schmid et al., 2002). Renaud and Willimas (2005) noted seasonal differences in dive durations, with longer dives (>30 min) during the winter and 15-min dives during the remainder of the year. Sasso and Witzell (2006) reported longer dives at night than during the day. Over a 12-hr period, Kemp's ridleys spend up to 96 percent of their time submerged (Byles, 1989; Gitschlag, 1996; Renaud and Williams, 2005; Sasso and Witzell, 2006).

- **Status—**The Kemp's ridley turtle is classified as endangered under the ESA; this is considered the world's most endangered sea turtle species (USFWS and NMFS, 1992b). The worldwide population declined from tens of thousands of nesting females in the late 1940s to approximately 300 nesting females in 1985 (TEWG, 2000). From 1985 to 1999, the number of nests at Rancho Nuevo increased at a mean rate of 11.3 percent per year (TEWG, 2000). Positive trends in 2005 were recorded in Rancho Nuevo, Tamaulipas (6,947 nests) on the eastern coast of Mexico, Barra del Tordo (701 nests), and Barra de Tepehuajes (1,610 nests) (USFWS, 2005). Nesting levels at Padre Island National Seashore in Texas, the site of a Kemp's ridley head-starting and imprinting program from 1978 to 1988, have shown a slow but steady rise throughout time (Shaver and Wibbels, 2007).

- **Habitat—**Kemp's ridley turtles occur in open ocean and *Sargassum* habitats of the North Atlantic Ocean as post-hatchlings and small juveniles (e.g., Manzella et al., 1991; Witherington and Hirama, 2006). They move as large juveniles and adults to benthic, nearshore feeding grounds along the U.S. Atlantic and Gulf coasts (Morreale and Standora, 2005). Habitats frequently utilized include warm-temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters where their preferred food, including the blue crab (*Callinectes sapidus)*, occurs (Lutcavage and Musick, 1985; Landry and Costa 1999; Seney and Musick, 2005). Models indicate that the most suitable habitats are less than 10 m (33 ft) in bottom depth with sea surface temperatures between 22 and 32°C (72 to 90°F) (Coyne et al., 2000). Seagrass beds and mud bottom, as well as live bottom, are important developmental habitats (Schmid and Barichivich, 2006). Postnesting Kemp's ridleys travel along coastal corridors generally shallower than 50 m (164 ft) in bottom depth (Morreale et al., 2007).

- **General Distribution—**Feeding grounds and developmental areas are found on the Atlantic and Gulf coasts of the U.S. Henwood (1987) and Gitschlag (1996) documented sightings and movements of juveniles within and among preferred habitats along both the Atlantic and Gulf coasts. Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in mid-Atlantic waters (Keinath et al., 1987; Musick and Limpus, 1997). Some Kemp's ridley juveniles may migrate as far north as New York and New England, arriving in these areas around June (Morreale and Standora, 2005). Most individuals throughout the range are immature, but the latitudinal gradient still exists (Morreale and Standora, 2005). A few larger individuals are reported in southern and mid-Atlantic states (Florida, Georgia, South Carolina, Virginia), but the vast majority are small (Morreale and Standora, 2005). In the northeastern waters of New York and Massachusetts, only small-sized Kemp's ridleys are documented.

During the winter, Kemp's ridleys are prompted by cooler water temperatures to leave northern developmental habitats and migrate south to warmer waters in Florida (Marquez-M., 1994). Migrations tend to take place in nearshore waters along the mid-Atlantic coast (Morreale and Standora, 2005; Morreale et al., 2007); juveniles and adults typically travel inshore of the 18 m (59 ft) isobath (Renaud and Williams, 2005). This migratory corridor is a narrow band running within continental shelf waters, possibly spanning the entire length of the U.S. Atlantic Coast (Morreale and Standora, 2005; Morreale et al., 2007). Seasonal movements continue until turtles reach sexual maturity, at which time, they return to breeding grounds in the Gulf of Mexico (Henwood and Ogren, 1987).

Individuals are known to overwinter in areas south of Cape Hatteras, North Carolina, although the majority of Kemp's ridleys stay in Florida near Cape Canaveral (Henwood and Ogren, 1987). Overwintering individuals may occasionally bury in the mud to hibernate (Schwartz, 1989; Marquez-M., 1994). Individuals that overwinter in southern North Carolina may subsequently moved into warmer waters (e.g., Gulf Stream or areas off South Carolina) during the mid-winter (Renaud, 1995; Morreale and Standora, 2005). For example, an individual tagged in Beaufort in 1989 was tracked to stay the winter in Onslow Bay, North Carolina, and subsequently move into the Gulf Stream when temperatures cooled close to shore in January 1990 (Renaud, 1995).

Nesting occurs primarily on a single nesting beach at Rancho Nuevo, Tamaulipas, on the eastern coast of Mexico (USFWS and NMFS, 1992), with a few additional nests in Texas, Florida, South Carolina, and North Carolina (Meylan et al., 1990; Weber, 1995; Caribbean Conservation Corporation, 1996; Foote and Mueller, 2002). The first successful nesting on the east coast of Florida occurred in 1996 just south of Daytona Beach in Volusia County (Godfrey, 1996). This individual nested twice in this area. Additional nesting attempts have been recorded in Palm Beach County and on the west coast of Florida (Meylan et al., 1990; Godfrey, 1996). In June 2003, the National Park Service (NPS) documented a female

Kemp's ridley nesting at Cape Lookout National Seashore in North Carolina (NPS, 2003).

Occurrence in the Proposed Site A USWTR—Kemp's ridleys are expected to occur within the vicinity of the Site A USWTR year-round. Water temperature is an influential factor in the occurrence and distribution of Kemp's ridleys within the Jacksonville OPAREA. Kemp's ridleys utilize developmental habitats in North Carolina, South Carolina, and Georgia from April through October (Morreale and Standora, 2005) and the majority of Kemp's ridleys overwinter off the coasts of Florida and Georgia (Henwood, 1987).

Kemp's ridleys nest infrequently in northern Florida with the highest density of nests occurring in the counties of Brevard to Palm Beach (FFWCC-FWRI, 2006a). There are no nests documented for Kemp's ridley in Duval County for the last 25 years and the closest nesting sites have been along Volusia County beaches (FFWCC, 2007).

Hawksbill Sea Turtle – Site A

- **General Description—**The hawksbill turtle is a small to medium-sized sea turtle; adults range between 65 and 90 cm (2.1 to 3.0 ft) in carapace length and typically weigh around 80 kg (176 lbs) (Witzell, 1983; NMFS and USFWS, 1993). Hawksbills are distinguished by their hawk-like beaks, posteriorly overlapping carapace scutes, and two pairs of claws on their flippers (NMFS and USFWS, 1993). The carapace is often brown or amber with irregularly radiating streaks of yellow, orange, black, and reddish-brown.

  Hawksbills are considered to be omnivorous during the later juvenile stage, feeding on encrusting organisms such as sponges, tunicates, bryozoans, algae, mollusks, and a variety of other items including crustaceans and jellyfish (Bjorndal, 1997). Older juveniles and adults are more specialized and feed primarily on sponges, which comprise as much as 95 percent of their diet in some locations (Witzell, 1983; Meylan, 1988).

  Hawksbills may have one of the longest routine dive times of all the sea turtles. Starbird et al. (1999) reported that inter-nesting females at Buck Island, USVI averaged 56 min dives with a maximum dive time of 74 min. Average dives during the day ranged from 34 to 65 min, while those at night were between 42 and 74 min. Data from time-depth recorders have indicated that foraging dives of immature hawksbills in Puerto Rico range from 9 to 14 min in duration, with a mean depth of 4.7 m (15.4 ft) (Van Dam and Diez, 1996). These individuals were found to be most active during the day. Changes in water temperature have an effect on the behavioral ecology of hawksbill turtles, with an increase in nocturnal dive duration with decreasing water temperatures during the winter (Storch et al., 2005).

- **Status—** The hawksbill turtle is listed as endangered under the ESA. This species is second only to the Kemp's ridley in terms of endangerment (NMFS and USFWS, 1993; Bass, 1994). There is designated critical habitat for the species in the Caribbean that includes the waters surrounding Mona and Monito islands, Puerto Rico (NMFS, 1998c).

- **Habitat—**Hawksbill turtles inhabit oceanic waters as post-hatchlings and small juveniles, where they are sometimes associated with driftlines and floating patches of *Sargassum* (Parker, 1995; Witherington and Hirama, 2006). The developmental habitats for juvenile benthic-stage hawksbills are the same as the primary feeding grounds for adults. They include tropical, nearshore waters associated with coral reefs, hard bottoms, or estuaries with mangroves (Musick and Limpus, 1997). Coral reefs are recognized as optimal hawksbill habitat for juveniles, sub-adults, and adults (NMFS and USFWS, 1993; Diez et al., 2003). In neritic habitats, resting areas for late juvenile and adult hawksbills are typically located in deeper waters, such as sandy bottoms at the base of a reef flat, than their foraging areas (Houghton et al., 2003). Late juveniles generally reside on shallow reefs less than 18 m (59 ft) deep. However, as they mature into adults, hawksbills move to deeper habitats and may forage to depths greater than 90 m (295 ft). Benthic-stage hawksbills are seldom found in waters beyond the continental or insular shelf, unless they are in transit between distant foraging or nesting grounds (NMFS and USFWS, 1993).

- **General Distribution—**Hawksbill turtles are circumtropical in distribution, generally occurring from 30°N to 30°S within the Atlantic, Pacific, and Indian oceans (Witzell, 1983). The hawksbill turtle has only rarely been recorded away from the tropics. In the Atlantic Ocean, this species is found throughout the Gulf of Mexico, the Greater and Lesser Antilles, and southern Florida, as well as along the mainland of Central America south to Brazil (NMFS and USFWS, 1993). The hawksbill is rare north of Florida (Lee and Palmer, 1981; Keinath et al., 1991; Parker, 1995; Plotkin, 1995; USFWS, 2001a), but small hawksbills have stranded as far north as Cape Cod, Massachusetts (NMFS, 2006i). Adult hawksbills are rarely documented in Florida waters, although nesting females occasionally visit beaches along the southeastern coast and the Florida Keys (Meylan and Redlow, 2006).

  Major foraging populations in U.S. waters occur in the vicinity of the coral reefs surrounding Mona Island, Puerto Rico and Buck Island, St. Croix, USVI (Starbird et al., 1999). Smaller populations of hawksbills reside in the hard bottom habitats that surround the Florida Keys and other small islands in Puerto Rico and the USVI (Witzell, 1983; NMFS and USFWS, 1993). Virtually all nesting is restricted between latitudes 25ºN and 35ºS. Hawksbill nesting in Florida has been reported from Cape Canaveral National Seashore south to Boca Grande Key and the Marquesas Islands and a single locality on the west coast (Longboat Key) (Meylan and Redlow, 2006).

Occurrence in the Proposed Site A USWTR—Although rare, hawksbills may occur within the Site A USWTR at any time during the year (DoN, 2008n). The majority of animals stranded or sighted in or near the action area are immature (Meylan, 1992; Parker, 1995). The hawksbill is a tropical species and is more likely to be found along the southern portion of Florida (NMFS, 2007e; Meylan and Redlow, 2006); however a recent hypothesis suggests that the Florida current and the Gulf Stream may represent a dispersal corridor for Caribbean and Gulf region post-hatchlings (Meylan and Redlow, 2006).

3.2.5.2 Site B

As discussed above, the southeast U.S. has the most diverse and abundant sea turtle populations in the U.S. All five species of sea turtles occurring in the Atlantic coastal waters off the eastern U.S. may be present in or around Site B.

Loggerhead Turtle – Site B

Loggerheads are resident off the coast of South Carolina year round. The major nesting area for the loggerhead in the western Atlantic is the southeastern United States. In South Carolina, the primary nesting beaches are between North Inlet and Prices' Inlet, but other beaches in the southern part of the state also have moderate nesting densities. These are mainly undeveloped nesting beaches between Kiawah Island and Hilton Head. The nesting season runs from mid May to mid August. The average clutch size in South Carolina is 126 eggs. The average incubation duration is 58 days. The loggerhead is the most common sea turtle to strand in South Carolina and the nesting population has declined three percent per year since records began in 1980 (SCDNR, 2007b).

Available data on sightings, strandings, and bycatch strongly demonstrate that the loggerhead is the most common sea turtle in the Charleston OPAREA and are expected to occur within the vicinity of the Site B USWTR. In 2007, there were 31 reported loggerhead strandings in Charleston County (Seaturtle.org, 2008).

Leatherback Turtle – Site B

Leatherback sea turtles are expected to occur throughout the Charleston OPAREA during all seasons, as they inhabit both oceanic and coastal environments (DoN, 2008n). Leatherbacks concentrate in different areas depending upon the season, due to factors including their highly migratory nature and the seasonal availability of jellyfish in particular regions of the SAB.

Since the leatherback is commonly found in relatively shallow continental waters along the entire U.S. Atlantic Coast, occurrence for the spring, summer, and fall ranges from the shoreline to the 200-m (656-ft) isobath. Survey data indicate that, during the winter, leatherbacks are concentrated mainly in the shelf waters south of Charleston, South Carolina. In 2007, there were no reported leatherback strandings in Charleston County (Seaturtle.org, 2008). In the summertime, expected occurrence is largely limited to coastal waters south of Jacksonville. Leatherbacks are expected to occur within the vicinity of the Site B USWTR during all seasons.

As a result of the leatherback's wide-ranging occurrence in waters off the southeast U.S. coast and the fact that this species is often incidentally captured by commercial shrimp trawling fisheries, all inshore and offshore waters adjacent to the U.S. Atlantic Coast between Cape Canaveral, Florida and the North Carolina-Virginia border (within the U.S. EEZ) are designated as a "leatherback conservation zone" year-round (NOAA Fisheries, 1995), an area where there are restrictions on shrimp trawling.

Green Turtle – Site B

South of Cape Hatteras, North Carolina, green sea turtles may occur year-round in waters between the shoreline and the 50-m (164-ft) isobath. The preferred habitats of this species are seagrass beds and worm-rock reefs, which are located primarily in shallow-water environments along the east coast (DoN, 2008n). Juvenile green turtles are found in South Carolina (ranging in size from 28 to 38 cm [11 to 15 in] in CCL) in shallow creeks, bays, and salt marshes feeding on epiphytic green algae such as sea lettuce. Green turtles have the greatest likelihood of occurring within the vicinity of the Site B USWTR during winter. In 2007, there were five reported green turtle strandings in Charleston County (Seaturtle, 2008).

Kemp's Ridley Turtle – Site B

Juvenile Kemp's ridleys (18 to 65 cm [11 to 26 in]) occur along the South Carolina coast during the summer. In 1992, there was one Kemp's ridley nest in South Carolina. In 2007, there were six reported Kemp's ridley strandings in Charleston County (Seaturtle, 2008). This species represents the second most common turtle to strand on the South Carolina coast. They feed on fast swimming crabs (e.g., blue crabs) and are sometimes caught by hook and line fishermen. Kemp's ridleys are expected to occur within the vicinity of the Site B USWTR year-round.

Hawksbill Sea Turtle – Site B

Sparse sighting, stranding, and bycatch data indicate that the occurrence of hawksbill sea turtles within the vicinity of the Charleston OPAREA is rare during all seasons (DoN, 2008n). In 2007, there were no hawksbill strandings in Charleston County or in South Carolina (Seaturtle, 2008). Although scientists believe hawksbills to be common inhabitants of the coastal waters off southeastern Florida, they are rare north of Florida (DoN, 2008n) and are not expected to occur in the vicinity of the USWTR Site B location.

3.2.5.3 Site C

The temperate inshore and nearshore waters of North Carolina host all five species of sea turtles throughout much of the year, most of which are immature individuals (Lee and Palmer, 1981; Lutcavage and Musick, 1985; Keinath et al., 1987, 1996; Byles, 1988; Barnard et al., 1989; Schwartz, 1989; Epperly et al., 1995a, b, c). Due to the narrowness of North Carolina's continental shelf near Cape Hatteras (and its close association with the western wall of the Gulf Stream), sea turtles are often concentrated in the shallow, nearshore waters (Epperly et al., 1995b; Keinath et al., 1996). Inshore and estuarine waters serve as important developmental habitat for juvenile loggerhead, green, and Kemp's ridley turtles (Epperly et al., 1995b).

Along the U.S. Atlantic coast, nesting has been known to occur as early as February and as late as October, although the official nesting season (the time of year when the vast majority of nesting activity occurs) begins in May and ends in August (Meylan et al., 1995; Webster and Cook, 2001). North Carolina and southern Virginia are recognized as the northern limit of nesting activity, (Schwartz, 1989; NCMFC, 2007). Adult sea turtles (primarily loggerheads, as well as a few greens and infrequent leatherbacks) most often visit ocean-facing beaches to nest in June and July. Although nesting is known to occur along the entire North Carolina coast, the highest levels of sea turtle nesting activity occur along Cape Lookout National Seashore and Onslow Beach (Hopkins and Richardson, 1984; Schwartz, 1989).

In 2006, 131 sea turtles nests (128 loggerhead and 3 green) were recorded along the 90-km (56-mi) stretch of beaches at Cape Lookout National Seashore including North Core, South Core, and Shackleford Banks (NPS, 2007a). Data from the Bogue Banks Sea Turtle Project (area including the ocean-facing beaches of Atlantic Beach, Pine Knoll Shores, Indian Beach/Salter Path, and Emerald Isle) report an average of 29 nests per year (primarily loggerhead) since 2002, with a high of 39 in 2003 (Holloman and Godfrey, 2007). Additionally, sea turtle nesting has been monitored on a stretch of military-controlled land (Camp LeJeune) at Onslow Beach since 1979. Approximately 18 km (11 mi) of beach are monitored annually from mid May through August. Sea turtle nesting (loggerhead and green turtles) is known to occur on Onslow Beach at an approximate density of 3.5 nests per km (5.6 nests per mi) (USFWS, 2002). With respect specifically to Riesley Pier (the landside USWTR location), nest density estimates are 5.1 nests per km (8.2 nests per mi) (with annual nesting of four nests per year) on a beach segment ranging from the pier to approximately 0.7 km (0.5 mi) north of the pier (USFWS, 2002).

Loggerhead Turtle – Site C

Loggerheads are the most commonly sighted species of sea turtle in the Cherry Point OPAREA, using North Carolina waters for overwintering, foraging, and traveling to nesting beaches (DoN, 2008l). Seasonal water temperatures influence loggerhead occurrence offshore North Carolina, although loggerheads are resident year-round south of Cape Hatteras. Occurrence trends to shelf waters throughout the year; during the winter, loggerhead presence may extend further offshore. A high concentration of loggerheads occurs in shelf waters offshore Maryland during the spring (DoN, 2008l). Spring and summer represent peak nesting times for loggerheads in North

Carolina; during these seasons, individuals may traverse the OPAREA en route to nesting beaches. Loggerheads are expected to occur within the vicinity of the USWTR Site C during all seasons.

Nesting activity along the entire North Carolina coast commences in the spring, peaking in the month of June (NCMFC, 2007). Loggerhead nesting is common on ocean facing beaches of North Carolina including Onslow Beach in the vicinity of the proposed USWTR shore landing site. In 2006, 33 loggerhead nests were reported on Bogue Banks (Holloman and Godfrey, 2007). Cordes and Rikard (2006) reported 136 loggerhead nests in Cape Lookout National Seashore for the 2005 season.

Leatherback Turtle – Site C

The leatherback is the second most-sighted species of sea turtle in the Cherry Point OPAREA. Compared to the other four sea turtles, the distribution of the leatherback is the most extensive within the OPAREA, with individuals inhabiting both oceanic and coastal waters as far north as the Gulf of Maine.

Although adult leatherbacks are common in the Atlantic Ocean off the coast of North Carolina at certain times of the year, nesting in the region is rare. In North America, the northeast coast of Florida was considered the northern limit for leatherback nesting until the early 1980s (Allen & Neill, 1957; Caldwell, 1959; Caldwell et al., 1956; Nichols & Du Toit, 1983; Seyle, 1985). Rabon et al. (2003) published a review and summary of leatherback nesting activities north of Florida. The first potential evidence of leatherback nesting in North Carolina was in 1966 in the form of an unconfirmed report of hatchlings found on South Core Banks, near Cape Lookout (Carteret County) (Schwartz, 1976, 1977). During the 1998 nesting season two confirmed nests were observed at Cape Hatteras National Seashore (Rabon et al., 2003). During the 2000 nesting season four leatherback nests were confirmed in North Carolina. Three nests were documented at Cape Hatteras National Seashore and one at Cape Lookout National Seashore. One leatherback nest was also confirmed in North Carolina (Cape Hatteras National Seashore) in 2002 (Rabon et al., 2003).

The North Carolina records constitute the northernmost, confirmed reports of leatherback nests along the east coast of the United States. Almost all *Dermochelys* nesting activity in North Carolina has been concentrated along beaches between Cape Lookout and Cape Hatteras. Leatherback sea turtles nest every two to three years and their average intraseasonal nesting interval is approximately nine to ten days (NMFS & USFWS, 1992b). Thus, Rabon et al. (2003) note that the nesting records reported for North Carolina could represent the activities of a single female. In addition to the summary provided by Rabon et al. (2003), more recent leatherback nesting activity in North Carolina has been reported. Cordes and Rikard (2006) reported seven nests in 2004 and five nests in 2005 from Cape Lookout National Seashore and Holloman and Godfrey (2006) reported two leatherback nests in 2005 on the island of Bogue Banks. The NPS also confirmed one leatherback nest in 2006 (NPS, 2007b).

Because leatherbacks on the east coast of the United States may nest as early as late February (Meylan et al., 1995), current data for North Carolina are likely an underestimate of actual leatherback nesting activity. Beach patrols usually commence in May or June to maximize observations of nesting loggerhead turtles; therefore, leatherback nests may have been missed (Rabon et al., 2003).

The majority of leatherback sightings within the Cherry Point OPAREA occur on the continental shelf, although several bycatch records exist for waters beyond the shelf break (DoN, 2008l). As evidenced by a combination of sighting and bycatch records, this species occurs in offshore waters, especially north of Cape Lookout (Lee and Palmer, 1981; Schwartz, 1989). The greatest concentrations of leatherbacks are expected to occur in North Carolina from mid-April through mid-October (Keinath et al., 1996); the greatest abundance of leatherbacks in the OPAREA is expected during the spring and summer. Seasonal movements of large subadult and adult leatherbacks have been documented by aerial surveys along the U.S. Atlantic coast; yet, leatherbacks are likely not constrained by seasonal temperature variations. Leatherback occurrence is seasonal along the U.S. Atlantic coast, with the number of sightings along the northern area of the coast increasing from winter to summer. Leatherbacks are expected to occur within the vicinity of the USWTR Site C during all seasons.

Green Turtle – Site C

Green turtles may occur within the vicinity of the USWTR Site C year-round (DoN, 2008l). Juvenile greens use developmental habitats adjacent to the OPAREA during the summer months as well as travel to and from these habitats during the spring and fall. During the winter, the highest concentration of greens occurs just north of Cape Canaveral, Florida, a known overwintering area for juveniles (DoN, 2008l). During spring, summer, and fall, high concentrations of greens occur offshore the more northern states, specifically North Carolina, Virginia, Delaware, and New Jersey. Year-round, green turtle occurrence records are clustered along the North Carolina coast and within shelf waters (DoN, 2008l).

Green turtle nesting is rare on the beaches of North Carolina. Holloman and Godfrey (2006) reported one green turtle nest in 2005 on the island of Bogue Banks. Cordes and Rikard (2006) also reported a single green turtle nest in Cape Lookout National Seashore for 2005.

Kemp’s Ridley Turtle– Site C

Kemp’s ridleys occur within the vicinity of the USWTR Site C year-round, although occurrence is most common during the winter and summer months (DoN, 2008l). Water temperature is likely the most influential factor in the seasonal occurrence of Kemp’s ridleys within the OPAREA. Kemp’s ridley hatchlings may occur offshore near the eastern edge of the OPAREA and Gulf Stream in *Sargassum*. Spring and fall appear to experience the greatest number of strandings.

Hawksbill Turtle– Site C

Although rare, hawksbills may occur within the vicinity of the USWTR Site C year-round (DoN, 2008l). Based upon sighting and stranding records, occurrences are generally expected to be inshore and within shelf waters (DoN, 2008l). As this species is typically tropical, any occurrences within the Site C area are likely to be accidental. Many hawksbill strandings in North Carolina have been small juveniles (Frick, 2001; Mazarella, 2001; Godfrey, 2003), suggesting individuals may enter the OPAREA from pelagic juvenile habitat. Yet as North Carolina waters do not offer optimal developmental habitat for juvenile or foraging habitat for adults (NMFS and USFWS, 1993; Diez et al., 2003), individuals would not be expected to remain in the OPAREA.

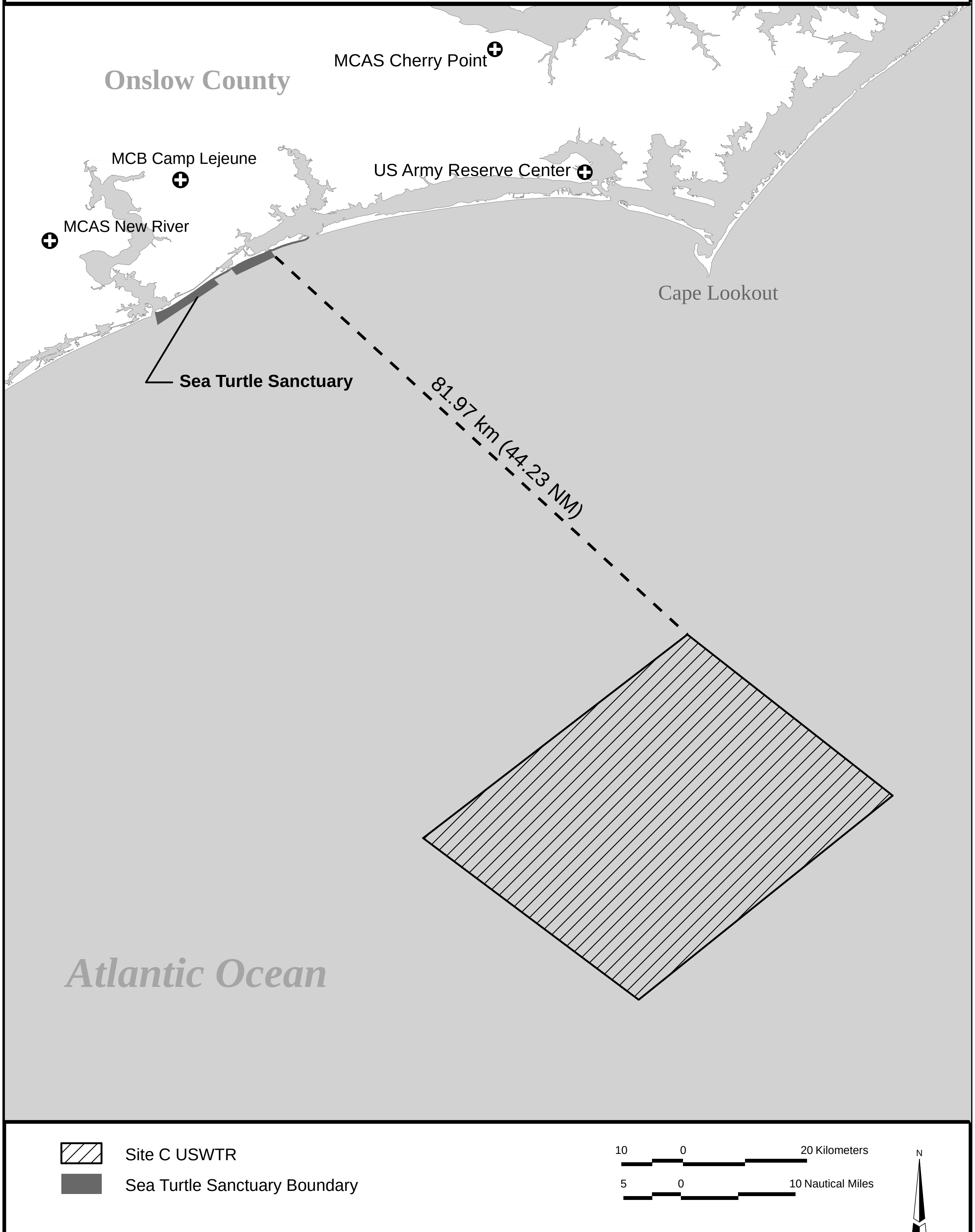
Sea Turtle Sanctuary

In 1980, the North Carolina state legislature established the first U.S. sea turtle sanctuary in the waters off Onslow Beach, Brown’s Island, and Bear Island. As described in the North Carolina Administrative Code (NCAC) 15A.03I.0107, it is unlawful to use commercial fishing equipment in the turtle sanctuary from June 1 to August 31 (NCAC, 2007). The sanctuary extends approximately 1 km (0.5 NM) offshore and is approximately 82 km (44 NM) from the Cherry Point OPAREA (Figure 3.2-6). This sanctuary was established under North Carolina fishery laws after researchers discovered that intense shrimp trawling coincided with high nesting activity along Onslow and Hammocks beaches (Schwartz, 1989a). Under this law, shrimp trawling within the sanctuary was prohibited between June 1 and August 31 unless permitted by the North Carolina fisheries director, who was given the right to modify the sanctuary within the described area and vary implementation between specified dates depending upon the existing environmental conditions (Godfrey, 2003). The Site C USWTR trunk cable would cross this sanctuary.

3.2.5.4 Site D

The waters off the Virginia and North Carolina coasts are important transitional habitat for juvenile sea turtles. Juvenile sea turtles along the U.S. Atlantic coast exhibit seasonal foraging movements, migrating north along the coast in the early spring to coastal development habitats and south in the fall (Morreale and Standora, 2005). Coastal waters of Virginia, particularly the Chesapeake Bay, serve as developmental habitat for juvenile loggerhead and Kemp’s ridley sea turtles that take up residency during the summer months (Lutcavage, 1981; Lutcavage and Musick, 1985; Mansfield and Musick, 2006). The presence of juvenile sea turtles in the Chesapeake Bay area and Virginia coastal waters peaks from May through early November (Lutcavage, 1981). As waters cool in the fall, most sea turtles emigrate out of the Chesapeake Bay and Virginia coastal waters to travel southward at least as far as Cape Hatteras, North Carolina to avoid cold stunning. Many turtles that overwinter off North Carolina remain near the edge of the Gulf Stream during the winter months of January and February (Epperly et al., 1995b; Musick and Limpus, 1997). As waters warm again in the spring, sea turtles migrate back inshore and expand their range northward. The coastal area immediately adjacent to Cape

Onslow Bay Sea Turtle Sanctuary



Source: North Carolina Marine Fisheries - 2004

Figure 3.2-6

Hatteras has long been recognized as a migratory pathway for loggerheads and Kemp's ridleys, as well as adult leatherbacks (Lee and Palmer, 1981).

Sea turtle occurrences in the VACAPES OPAREA peak during spring and fall, as turtles migrate to northern summer foraging grounds and again in the fall as they migrate to southern over-wintering habitats. Sea turtle concentrations are widely distributed along the east coast and into the Chesapeake Bay during the summer resulting in lower concentrations within the OPAREA during this time. The lowest concentrations of sea turtles are expected to occur during the winter (DoN, 2008m).

Loggerhead Turtle – Site D

Loggerheads occur year-round in the VACAPES OPAREA using waters of the OPAREA for foraging and transit to nesting beaches. Seasonal water temperatures influence loggerhead occurrence within the OPAREA. A high concentration of loggerheads occurs in shelf waters offshore Maryland during the spring and northern North Carolina during the fall (DoN, 2008m). During spring and fall, loggerheads are likely transiting the OPAREA to access summer foraging or overwintering habitats. Loggerheads are expected to occur in the Site D USWTR year-round.
Sea turtles are known to nest along Virginia's eastern shore, the Virginia Beach oceanfront, and coastal North Carolina, including the Outer Banks (Mansfield, 2006). Back Bay National Wildlife Refuge (NWR) has monitored sea turtle nesting in Virginia Beach, Virginia since 1970 (Cross and James, 2001). During the 2005 nesting season, six loggerhead nests and one green turtle nest were documented at Back Bay NWR (USFWS, 2005).

Leatherback Turtle – Site D

Leatherbacks are found year-round in the VACAPES OPAREA with the greatest occurrence during the summer. Based on a combination of sighting and bycatch records, this species may occur in OPAREA shelf waters or offshore waters just beyond the shelf break (DoN, 2008m). The greatest concentrations of leatherbacks expected to occur in the OPAREA vary seasonally by location. For example, leatherback presence is expected to peak in Virginia in May and July and in North Carolina from mid-April through mid-October (Keinath et al., 1996). Seasonal movements of large subadult and adult leatherbacks have been documented by aerial surveys along the U.S. Atlantic coast; yet, leatherbacks are likely not constrained by seasonal temperature variations. Leatherback occurrence is seasonal along the U.S. Atlantic coast, with the number of sightings along the northern area of the coast increasing from winter to summer. Leatherback turtles are expected to occur in the Site D USWTR during the spring, summer, and fall months.

Green Turtle – Site D

Green turtles may occur throughout the Site D USWTR from spring through fall, and are least common within the OPAREA during the winter (DoN, 2008m). Summer represents the peak time for green turtle occurrence in the OPAREA due to the presence of summer developmental foraging habitat along the coast (DoN, 2008m).

Kemp's Ridley Turtle– Site D

Kemp's ridleys occur within the Site D USWTR year-round although occurrence is most common during the summer. Water temperature is likely the most influential factor in the seasonal occurrence of Kemp's ridleys within the OPAREA. Juvenile Kemp's ridleys are the second most common, after loggerheads, to use Virginia developmental habitat (Mansfield, 2006). Kemp's ridley hatchlings may occur offshore near the eastern edge of the OPAREA and Gulf Stream in *Sargassum* (DoN, 2008m). Spring and fall appear to experience the greatest number of strandings (DoN, 2008m).

Hawksbill Turtle– Site D

Hawksbills are rare within the Site D USWTR yet may occur throughout the year. Based upon limited data, occurrences are expected to be more common within shelf waters or along the shelf break. As this species is typically tropical, any occurrences within the OPAREA are likely accidental. Many hawksbill strandings adjacent to the OPAREA have been small juveniles (Frick, 2001; Mazarella, 2001; Godfrey, 2003) suggesting individuals may enter the OPAREA from pelagic juvenile habitat. Sightings and bycatch records along the shelf break may support this (DoN, 2008m). However, OPAREA waters do not offer optimal developmental habitat for juvenile or foraging habitat for adults (NMFS and USFWS, 1993; Diez et al., 2003), and individuals would not be expected to remain in the OPAREA.

3.2.6 Marine Mammals

There are 35 marine mammal species with possible or confirmed occurrence in the combined Jacksonville and Charleston OPAREAs, 38 species in the Cherry Point OPAREA, and 40 species in the VACAPES OPAREA (Table 3.2-3). Marine mammals include cetaceans (whales, dolphins, and porpoises), pinnipeds (seals), and a sirenian species (manatee).

As in the previous subchapter, the information provided here also relies on the data gathered in the Navy's MRA program updates for the JAX/CHASN OPAREA (DoN, 2008n), the Cherry Point OPAREA (DoN, 2008l), and the VACAPES OPAREA (DoN, 2008m). The OPAREA data were used to provide a regional context for each marine mammal species. This section refers in many cases to the entire OPAREAs; however, animals may be found outside typical distribution ranges described within the MRA. As shown in Figures 2-13, 2-17, 2-21, and 2-25, each proposed USWTR encompasses a small portion of each OPAREA.

Table 3.2-3

Marine Mammal Species of the
Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs
and their status under the Endangered Species Act (ESA)

Species	Scientific Name	Status
Order Cetacea		
Suborder Mysticeti (baleen whales)		
Family Balaenidae (right whales)		
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Family Balaenopteridae (rorquals)		
Humpback whale	*Megaptera novaeangliae*	Endangered
Minke whale	*Balaenoptera acutorostrata*	
Bryde's whale	*Balaenoptera edeni*	
Sei whale	*Balaenoptera borealis*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Suborder Odontoceti (toothed whales)		
Family Physeteridae (sperm whale)		
Sperm whale	*Physeter macrocephalus*	Endangered
Family Kogiidae (pygmy sperm whales)		
Pygmy sperm whale	*Kogia breviceps*	
Dwarf sperm whale	*Kogia sima*	
Family Ziphiidae (beaked whales)		
Cuvier's beaked whale	*Ziphius cavirostris*	
True's beaked whale	*Mesoplodon mirus*	
Gervais' beaked whale	*Mesoplodon europaeus*	
Sowerby's beaked whale	*Mesoplodon bidens*	
Blainville's beaked whale	*Mesoplodon densirostris*	
Northern bottlenose whale	*Hyperoodon ampullatus*	
Family Delphinidae (dolphins)		
Rough-toothed dolphin	*Steno bredanensis*	
Bottlenose dolphin	*Tursiops truncatus*	
Pantropical spotted dolphin	*Stenella attenuata*	
Atlantic spotted dolphin	*Stenella frontalis*	
Spinner dolphin	*Stenella longirostris*	
Clymene dolphin	*Stenella clymene*	
Striped dolphin	*Stenella coeruleoalba*	
Common dolphin	*Delphinus delphis*	
Fraser's dolphin	*Lagenodelphis hosei*	
White-beaked dolphin	*Lagenorhynchus albirostris*	
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	
Risso's dolphin	*Grampus griseus*	
Melon-headed whale	*Peponocephala electra*	
Pygmy killer whale	*Feresa attenuata*	
False killer whale	*Pseudorca crassidens*	
Killer whale	*Orcinus orca*	
Long-finned pilot whale	*Globicephala melas*	
Short-finned pilot whale	*Globicephala macrorhynchus*	
Family Phocoenidae (porpoises)		
Harbor porpoise	*Phocoena phocoena*	

Table 3.2-3 (cont'd)

Marine Mammal Species of the
Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs
and their status under the Endangered Species Act (ESA)

Species	Scientific Name	Status
Order Carnivora		
Suborder Pinnipedia (seals, sea lions, walruses)		
Family Phocidae (true seals)		
Harbor seal	*Phoca vitulina*	
Gray seal	*Halichoerus grypus*	
Harp seal	*Pagophilus groenlandicus*	
Hooded seal	*Cystophora cristata*	
Order Sirenia		
Family Trichechidae (manatees)		
West Indian manatee	*Trichechus manatus*	Endangered
Notes: Naming convention matches that used in NOAA stock assessment reports.		
Source: DoN, 2008l, m, n		

Once again, it is important to note that the occurrence designations are predictions based on the likelihood of encountering a species in a given area, and are not intended to provide a measure of density or abundance. These predictions are based on occurrence data and the species' known distributions and habitat preferences. Each species description below concludes with a determination of that species' anticipated occurrence in the proposed USWTR sites.

The assemblages of marine mammals at each of the USWTR sites differ even though the sites are relatively close to one another. Those marine mammal groups south of Cape Hatteras (in both the JAX/CHASN and Cherry Point OPAREA vicinities) tend to have a warm-temperate and tropical composition, while those in the VACAPES area have a warm- and cool-temperate overlapping distribution.

3.2.6.1 Site A

The Site A USWTR is located within the Jacksonville OPAREA (Figure 2-13). Thirty-five marine mammal species have confirmed or potential occurrence in the proposed Jacksonville OPAREA. These include 32 cetacean, two pinniped, and one sirenian species (DoN, 2008n) (See Table 3.2-3). Although these 35 marine mammal species may have recorded sightings or strandings in or near the study area, only 15 of those species are considered to occur regularly in the region. The remaining species are considered extralimital indicating that there are one or more records of an animal's presence in the study area, but it is considered beyond the normal range of the species. Some cetacean species are resident in the area year-round (e.g., bottlenose dolphins), while others (e.g., North Atlantic right and humpback whales) occur seasonally as they migrate through the area. Following is a general description of the marine mammals that may occur in the Jacksonville OPAREA and, more specifically, in the vicinity of the Site A USWTR.

Any occurrences of the hooded (*Cystophora cristata*) and harbor seals (*Phoca vitulina*) would be considered extralimital, since the proposed range area is well south of these species' typical ranges (DoN, 2007a, 2008n). These occurrences are discussed here, but based on this information, pinnipeds are not included in this report.

Mysticetes

Records for baleen whales in the Jacksonville OPAREA include the North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae),* minke whale (*Balaenoptera acutorostrata*), Bryde's whale (*Balaenoptera edeni*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), and blue whale (*Balaenoptera musculus*).

North Atlantic Right Whale – Site A

- **General Description—**Adults are robust and may reach 18 m (59 ft) in length (Jefferson et al., 1993). North Atlantic right whales feed on zooplankton, particularly large calanoid copepods such as *Calanus* (Kenney et al., 1985; Beardsley et al., 1996; Baumgartner et al., 2007).

  Status—The North Atlantic right whale is one of the world's most endangered large whale species (Clapham et al., 1999; Perry et al., 1999; IWC, 2001). 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 stock assessment report (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. The North Atlantic right whale is under the jurisdiction of the NMFS. The recovery plan for the North Atlantic right whale was published in 2005 (NMFS, 2005a).

  This species is presently declining in number (Caswell et al., 1999; Kraus et al., 2005). Kraus et al. (2005) noted that the recent increases in birth rate were insufficient to counter the observed spike in human-caused mortality that has recently occurred.

  The coastal waters off the southeastern U.S. support the only known calving ground for the North Atlantic right whale. In the mid 1990s, the Navy, USCG, USACE, and NMFS entered into a Memorandum of Agreement pursuant to the ESA. The Early Warning System (EWS) (Right Whale Sighting Advisory System) is a result of that agreement. In an effort to reduce ship collisions with critically endangered North Atlantic right whales, the EWS was initiated in 1994 for the calving region along the southeastern U.S. coast. This system was extended in 1996 to the feeding areas off New England (MMC, 2003).

The EWS is a collaborative effort which involves comprehensive aerial surveys conducted during the North Atlantic right whale calving season. Surveys are flown daily, weather permitting, from December 1st through March 31st. East-west transects are flown from the shoreline to approximately 56 to 65 km (30 to 35 NM) offshore. The purpose of the surveys is to locate North Atlantic right whales, and provide whale detection and reporting information to mariners in the calving ground in an effort to avoid collisions with this endangered species. When a North Atlantic right whale is sighted, information from the aerial survey aircraft is passed to a ground contact. The ground contact e-mails the sighting information to a wide network distribution which includes FACSFAC JAX, the USCG, the USACE, and non-profit and commercial interests. Additionally, the ground contact follows up with a call to FACSFAC JAX to provide further information if necessary.

FACSFAC JAX records this information and disseminates it to all Navy vessels and aircraft operating in the consultation area via the Secret Internet Protocol Router Network (SIPRNET) system. General sighting information and reporting procedures are broadcasted over the following methods: NOAA weather radio, USCG NAVTEX system, and Broadcast Notice to Mariners over VHF marine-band radio channel 16. The EWS is a wide communication effort to ensure that all vessels in the area are aware of the most recent right whale sightings and can avoid them.

In 1999, a Mandatory Ship Reporting System was implemented by the USCG (USCG, 1999; 2001). This reporting system requires specified vessels (Navy ships are exempt) to report their location while in the nursery and feeding areas of the right whale (Ward-Geiger et al., 2005). At the same time, ships receive information on locations of North Atlantic right whale sightings in order to avoid whale collisions. Reporting takes place in the southeastern U.S. from 15 November through 15 April. In the northeastern U.S., the reporting system is year-round and the geographical boundaries include the waters of Cape Cod Bay, Massachusetts Bay, and the Great South Channel east and southeast of Massachusetts.

- **Diving Behavior—**Dives of 5 to 15 min or longer have been reported (CETAP, 1982; Baumgartner and Mate, 2003), but can be much shorter when feeding (Winn et al., 1995). Foraging dives in the known feeding high-use areas are frequently near the bottom of the water column (Goodyear, 1993; Mate et al., 1997; Baumgartner et al., 2003). Baumgartner and Mate (2003) found that the average depth of a right whale dive was strongly correlated with both the average depth of peak copepod abundance and the average depth of the mixed layer's upper surface. Right whale feeding dives are characterized by a rapid descent from the surface to a particular depth between 80 and 175 m (262 to 574 ft), remarkable fidelity to that depth for 5 to 14 min, and then rapid ascent back to the surface (Baumgartner and Mate, 2003). Longer surface intervals have been observed for reproductively active females and their calves (Baumgartner and Mate, 2003). The longest tracking of a right whale is of an adult female which migrated 1,928 km (1,040 NM) in 23 days (mean was 3.5 km/hr [1.9 NM/hr) from 40 km (22 NM) west of Browns Bank (Bay of Fundy) to Georgia (Mate and Baumgartner, 2001).

- **Acoustics and Hearing—**Northern right whales produce a variety of sounds, including moans, screams, gunshots, blows, upcalls, downcalls, and warbles that are often linked to specific behaviors (Matthews et al., 2001; Laurinolli et al., 2003; Vanderlaan et al., 2003; Parks et al., 2005; Parks and Tyack, 2005). Sounds can be divided into three main categories: (1) blow sounds; (2) broadband impulsive sounds; and (3) tonal call types (Parks and Clark, 2007). Blow sounds are those coinciding with an exhalation; it is not known whether these are intentional communication signals or just produced incidentally (Parks and Clark, 2007). Broadband sounds include non-vocal slaps (when the whale strikes the surface of the water with parts of its body) and the "gunshot" sound; data suggests that the latter serves a communicative purpose (Parks and Clark, 2007). Tonal calls can be divided into simple, low-frequency, stereo-typed calls and more complex, frequency-modulated (FM), higher-frequency calls (Parks and Clark, 2007). Most of these sounds range in frequency from 0.02 to 15 kHz (dominant frequency range from 0.02 to less than 2 kHz; durations typically range from 0.01 to multiple seconds) with some sounds having multiple harmonics (Parks and Tyack, 2005). Source levels for some of these sounds have been measured as ranging from 137 to 192 decibels at the reference level of one micropascal (dB re 1 μPa) root mean square (rms) (Parks et al., 2005; Parks and Tyack, 2005). In certain regions (i.e., northeast Atlantic), preliminary results indicate that right whales vocalize more from dusk to dawn than during the daytime (Leaper and Gillespie, 2006).

  Recent morphometric analyses of northern right whale inner ears estimates a hearing range of approximately 0.01 to 22 kHz based on established marine mammal models (Parks et al., 2004; Parks and Tyack, 2005; Parks et al., 2007). In addition, Parks et al. (2007) estimated the functional hearing range for right whales to be 15 Hz to 18 kHz. Nowacek et al. (2004) observed that exposure to short tones and down sweeps, ranging in frequency from 0.5 to 4.5 kHz, induced an alteration in behavior (received levels of 133 to 148 dB re 1 μPa), but exposure to sounds produced by vessels (dominant frequency range of 0.05 to 0.5 kHz) did not produce any behavioral response (received levels of 132 to 142 dB re 1 μPa).

- **Habitat—**North Atlantic right whales on the winter calving grounds are most often found in very shallow, nearshore regions within cooler SSTs inshore of a mid-shelf front (Kraus et al., 1993; Ward, 1999). High whale densities can extend more northerly than the current defined boundary of the calving critical habitat in response to interannual variability in regional SST distribution (Garrison, 2007). Warm Gulf Stream waters appear to represent a thermal limit (both southward and eastward) for right whales (Keller et al., 2006).

The feeding areas are characterized by bottom topography, water column structure, currents, and tides that combine to physically concentrate zooplankton into extremely dense patches (Wishner et al., 1988; Murison and Gaskin, 1989; Macaulay et al., 1995; Beardsley et al., 1996; Baumgartner et al., 2003).

- **General Distribution—**Right whales occur in sub-polar to temperate waters. The North Atlantic right whale was historically widely distributed, ranging from latitudes of 60°N to 20°N prior to serious declines in abundance due to intensive whaling (e.g., NMFS, 2006q; Reeves et al., 2007). North Atlantic right whales are found primarily in continental shelf waters between Florida and Nova Scotia (Winn et al., 1986). Most sightings are concentrated within five high-use areas: coastal waters of the southeastern U.S. (Georgia and Florida), Cape Cod and Massachusetts Bays, the Great South Channel, the Bay of Fundy, and the Nova Scotian Shelf (Winn et al., 1986; NMFS, 2005a). Of these, one calving and two feeding areas in U.S. waters are designated as critical habitat for North Atlantic right whales under the ESA (NMFS, 1994; NMFS, 2005a) (Figure 3.2-7). The critical habitat designated waters off Georgia and northern Florida are the only known calving ground for western North Atlantic right whales, with use concentrated in the winter (as early as November and through March) (Winn et al., 1986). The feeding grounds of Cape Cod Bay which have concentrated use in February through April (Winn et al., 1986; Hamilton and Mayo, 1990) and the Great South Channel east of Cape Cod with concentrated use in April through June (Winn et al., 1986; Kenney et al., 1995) have also been designated as critical habitat for the North Atlantic right whale (Figure 3.2-7).

Most North Atlantic right whale sightings follow a well-defined seasonal migratory pattern through several consistently utilized habitats (Winn et al., 1986). It should be noted, however, that some individuals may be sighted in these habitats outside the typical time of year and that migration routes are poorly known (Winn et al., 1986). Right whales typically migrate within 65 km (35 NM) of shore, but individuals have been observed farther offshore (Knowlton, 1997). In fact, trans-Atlantic migrations of North Atlantic right whales between the eastern U.S. coast and Norway have been documented (Jacobsen et al., 2004) which suggests a possible offshore migration path.

During the spring through early summer, North Atlantic right whales are found on feeding grounds off the northeastern U.S. and Canada. During the winter (as early as November and through March), North Atlantic right whales may be found in coastal waters off North Carolina, Georgia, and northern Florida (Winn et al., 1986).

Designated Critical Habitats for North Atlantic Right Whales

North Atlantic Right Whale Critical Habitat
USWTR Candidate Sites
OPAREAs

100 0 100 Miles
200 0 200 Kilometers
N

Figure 3.2-7

Occurrence in the Site A USWTR—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, 2007). The North Atlantic right whale may occur year-round from the shore to the continental shelf break in the OPAREA, with a peak concentration during November through March. The North Atlantic right whale is expected to occur in the Site A USWTR.

Designated North Atlantic Right Whale Critical Habitat

One calving area and two feeding areas in U.S. waters are designated as critical habitat for North Atlantic right whales under the ESA (Figure 3.2-7) (NMFS, 1994; NMFS, 2005a). The critical habitat designated waters off Georgia and northern Florida are the only known calving ground for western North Atlantic right whales, with use concentrated in the winter (as early as November and through March) (Winn et al., 1986). The feeding grounds of Cape Cod Bay which have individuals in February through April (Winn et al., 1986; Hamilton and Mayo, 1990) and the Great South Channel east of Cape Cod with use in April through June (Winn et al., 1986; Kenney et al., 1995) have also been designated as critical habitat for the North Atlantic right whale. Critical habitat designations affect federal agency actions or federally-funded or permitted activities.

Humpback Whale –Site A

- **General Description—**Adult humpback whales are 11 to 16 m (36 to 52 ft) in length and are more robust than other rorquals. The body is black or dark gray, with very long (about one-third of the body length) flippers that are usually at least partially white (Jefferson et al., 1993; Clapham and Mead, 1999). Humpback whales feed on a wide variety of invertebrates and small schooling fishes, including euphausiids (krill); the most common fish prey are herring, mackerel, sand lance, sardines, anchovies, and capelin (Clapham and Mead, 1999).

- **Status—**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. The humpback whale is listed as endangered under the ESA and management of the species is under the jurisdiction of the NMFS. The recovery plan for the humpback whale was issued in 1991 (NMFS, 1991a).

- **Diving Behavior—**Humpback whale diving behavior depends on the time of year (Clapham and Mead, 1999). In summer, most dives last less than 5 min; those exceeding 10 min are atypical. In winter (December through March), dives average 10 to 15 min; dives of greater than 30 min have been recorded (Clapham and Mead, 1999). Although humpback whales have been recorded to dive as deep as 500 m (1,640 ft) (Dietz et al., 2002), on the feeding grounds they spend the majority of their time in the upper 120 m (394 ft) of the water column (Dolphin, 1987; Dietz et al., 2002). Recent D-tag work revealed that humpbacks are usually only a few meters below the water's surface while foraging (Ware et al., 2006). On wintering grounds, Baird et al. (2000) recorded dives deeper than 100 m (328 ft).

- **Acoustics and Hearing—**Humpback whales are known to produce three classes of vocalizations: (1) "songs" in the late fall, winter, and spring by solitary males; (2) sounds made within groups on the wintering (calving) grounds; and (3) social sounds made on the feeding grounds (Thomson and Richardson, 1995).

  The best-known types of sounds produced by humpback whales are songs, which are thought to be breeding displays used only by adult males (Helweg et al., 1992). Singing is most common on breeding grounds during the winter and spring months, but is occasionally heard outside breeding areas and out of season (Mattila et al., 1987; Gabriele et al., 2001; Gabriele and Frankel, 2002; Clark and Clapham, 2004). Humpback song is an incredibly elaborate series of patterned vocalizations, which are hierarchical in nature (Payne and McVay, 1971). There is geographical variation in humpback whale song, with different populations singing different songs, and all members of a population using the same basic song; however, the song evolves over the course of a breeding season, but remains nearly unchanged from the end of one season to the start of the next (Payne et al., 1983).

  Social calls are from 50 hertz (Hz) to over 10 kHz, with dominant frequencies below 3 kHz (Silber, 1986). Female vocalizations appear to be simple; Simão and Moreira (2005) noted little complexity. The male song, however, is complex and changes between seasons. Components of the song range from under 20 Hz to 4 kHz and occasionally 8 kHz, with source levels measured between 151 and 189 dB re 1 μPa and high-frequency harmonics extending beyond 24 kHz (Au et al., 2001; Au et al., 2006). Songs have also been recorded on feeding grounds (Mattila et al., 1987; Clark and Clapham, 2004). The main energy lies between 0.2 and 3.0 kHz, with frequency peaks at 4.7 kHz. "Feeding" calls, unlike song and social sounds, are highly stereotyped series of narrow-band trumpeting calls.

They are 20 Hz to 2 kHz, less than 1 second (s) in duration, and have source levels of 162 to 192 dB re 1 μPa. The fundamental frequency of feeding calls is estimated to be approximately 500 Hz (D'Vincent et al., 1985; Thompson et al., 1986). Zoidis et al. (2008) recorded humpback whale calves in Hawaii and reported that they produced simple structured vocalizations that were mostly low frequency (140 to 4,000 Hz with a mean of 220 Hz).

More recently, the acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic has been documented with D-tags (Stimpert et al., 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple bouts of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (2007) termed these sounds "mega-clicks" which showed relatively low received levels at the D-tags with the majority of acoustic energy below 2 kHz. More data are required to facilitate a more complete understanding of this newly-described acoustic, dive and feeding behavior of humpback whales. Humpback whale calves produce low frequency vocalizations (mean = 220 Hz) that are simple in structure, and are narrow in bandwidth (mean = 2 kHz) (Zoidis et al., 2008).

While no measured data on hearing ability are available for this species, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. Houser et al. (2001) produced the first humpback whale audiogram (using a mathematical model). The predicted audiogram indicates sensitivity to frequencies from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 and 6 kHz. Au et al. (2006) noted that if the popular notion that animals generally hear the totality of the sounds they produce is applied to humpback whales, this suggests that its upper frequency limit of hearing is as high as 24 kHz.

- **Habitat—**Although humpback whales typically travel over deep, oceanic waters during migration, their feeding and breeding habitats are mostly in shallow, coastal waters over continental shelves (Clapham and Mead, 1999). Shallow banks or ledges with high sea-floor relief characterize feeding grounds (Payne et al., 1990; Hamazaki, 2002). The habitat requirements of wintering humpbacks appear to be determined by the conditions necessary for calving. Optimal calving conditions are warm waters (24° to 28°C [75 to 82°F) and relatively shallow, low-relief ocean bottom in protected areas (i.e., behind reefs) (Sanders et al., 2005). Females with calves occur in significantly shallower waters than other groups of humpback whales, and breeding adults use deeper, more offshore waters (Smultea, 1994; Ersts and Rosenbaum, 2003).

- **General Distribution—**Humpback whales are globally distributed in all major oceans and most seas. They are generally found during the summer on high-latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs. Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep water during migration (Clapham and Mattila, 1990; Calambokidis et al., 2001).

In the North Atlantic Ocean, humpbacks are found from spring through fall on feeding grounds that are located from south of New England to northern Norway (NMFS, 1991). 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; Smith et al., 1999; Stevick et al., 2003b).
There has been an increasing occurrence of humpbacks, which appear to be primarily juveniles, during the winter along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al., 1993; Swingle et al., 1993; Wiley et al., 1995; Laerm et al., 1997). It has recently been proposed that the mid-Atlantic region primarily represents a supplemental winter feeding ground, which is also an area of mixing of humpback whales from different feeding stocks (Barco et al., 2002).

<u>Occurrence in the Site A USWTR</u>—Humpback whales may occur throughout the Jacksonville OPAREA (including the 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 vicinity of the Site A area during summer, since they should occur further north on their feeding grounds; however, rare occurrences are possible, since there are documented sightings to the south in the Bahamas during this time of year (DoN, 2008n).

Minke Whale – Site A

- **General Description—**Minke whales are small rorquals; adults reach lengths of just over 9 m (Jefferson et al., 1993). In the western North Atlantic, minke whales feed primarily on schooling fish, such as sand lance, capelin, herring, and mackerel (Kenney et al., 1985), as well as copepods and krill (Horwood, 1990).

- **Status—**There are four recognized populations in the North Atlantic Ocean: Canadian East Coast, West Greenland, Central North Atlantic, and Northeastern North Atlantic (Donovan, 1991). Minke whales off the eastern U.S. are considered to be part of the Canadian East Coast stock which inhabits the area from the eastern half of the Davis Strait to 45° West (W) and south to the Gulf of Mexico (Waring et al., 2008). The best estimate of abundance for the Canadian East Coast stock is 3,312 individuals (Waring et al., 2008). The minke whale is under the jurisdiction of NMFS.

- **Diving Behavior—**Diel and seasonal variation in surfacing rates are documented for this species; this is probably due to changes in feeding patterns (Stockin et al., 2001). Dive durations of 7 to 380 s are recorded in the eastern North Pacific and the eastern North Atlantic (Lydersen and Øritsland, 1990; Stern, 1992; Stockin et al., 2001). Mean time at the surface averages 3.4 s (standard deviation [SD] was ± 0.3 s) (Lydersen and Øritsland, 1990). Stern (1992) described a general surfacing pattern of minke whales consisting of about four surfacings interspersed by short-duration dives averaging 38 s. After the fourth surfacing, there was a longer duration dive ranging from approximately 2 to 6 min.

- **Acoustics and Hearing—**Recordings of minke whale sounds indicate the production of both high- and low-frequency sounds (range of 0.06 to 20 kHz) (Beamish and Mitchell, 1973; Winn and Perkins, 1976; Thomson and Richardson, 1995; Mellinger et al., 2000). Minke whale sounds have a dominant frequency range of 0.06 to greater than 12 kHz, depending on sound type (Thomson and Richardson, 1995; Edds-Walton, 2000). Mellinger et al. (2000) described two basic forms of pulse trains: a "speed-up" pulse train (dominant frequency range: 0.2 to 0.4 kHz) with individual pulses lasting 40 to 60 ms, and a less common "slow-down" pulse train (dominant frequency range: 50 to 0.35 kHz) lasting for 70 to 140 ms. Source levels for this species have been estimated to range from 151 to 175 dB re 1 μPa (Ketten, 1998). Gedamke et al. (2001) recorded a complex and stereotyped sound sequence ("star-wars vocalization") in the southern hemisphere that spanned a frequency range of 50 Hz to 9.4 kHz. Broadband source levels between 150 and 165 dB re 1 μPa were calculated for this star-wars vocalization. "Boings" recorded in the North Pacific have many striking similarities to the star-wars vocalization in both structure and acoustic behavior. "Boings" are produced by minke whales and are suggested to be a breeding display, consisting of a brief pulse at 1.3 kHz followed by an amplitude-modulated call with greatest energy at 1.4 kHz, with slight frequency modulation over a duration of 2.5 s (Rankin and Barlow, 2005).

  While no empirical data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes are most adapted to hear low to infrasonic frequencies.

- **Habitat—**Off eastern North America, minke whales generally remain in waters over the continental shelf, including inshore bays and estuaries (Mitchell and Kozicki, 1975; Murphy, 1995; Mignucci-Giannoni, 1998). However, based on whaling catches and global surveys, there is an offshore component to minke whale distribution (Slijper et al., 1964; Horwood, 1990; Mitchell, 1991).

- **General Distribution—**Minke whales are distributed in polar, temperate, and tropical waters (Jefferson et al., 1993); they are less common in the tropics than in cooler waters. This species is more abundant in New England waters than in the mid-Atlantic (Hamazaki, 2002; Waring et al., 2006). The southernmost sighting in recent NMFS shipboard surveys was of one individual offshore of the mouth of Chesapeake Bay, in waters with a bottom depth of 3,475 m (11,400 ft) (Mullin and Fulling, 2003). Minke whales off the U.S. Atlantic coast apparently migrate offshore and southward in winter (Mitchell, 1991). Minke whales are known to occur during the winter months (November through March) in the western North Atlantic from Bermuda to the West Indies (Winn and Perkins, 1976; Mitchell, 1991; Mellinger et al., 2000).

Mating is thought to occur in October to March but has never been observed (Stewart and Leatherwood, 1985). However, location of specific breeding grounds is unknown though it is thought to be in areas of low latitude (Jefferson et al., 2008).

Occurrence in the Site A USWTR—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 Action Area 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 Jacksonville 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.

Bryde's Whale – Site A

- **General Description—**Bryde's whales usually have three prominent ridges on the rostrum (other rorquals generally have only one) (Jefferson et al., 1993). Adults can be up to 15.5 m (51 ft) in length (Jefferson et al., 1993). Bryde's whales can be easily confused with sei whales. Bryde's whales are lunge-feeders, feeding on schooling fish and krill (Nemoto and Kawamura, 1977; Siciliano et al., 2004; Anderson, 2005).

- **Status—**No abundance information is currently available for Bryde's whales in the western North Atlantic (Waring et al., 2008). Bryde's whales are under the jurisdiction of NMFS.

- **Diving Behavior—**Bryde's whales are lunge-feeders, feeding on schooling fish and krill (Nemoto and Kawamura, 1977; Siciliano et al., 2004; Anderson, 2005). Cummings (1985) reported that Bryde's whales may dive as long as 20 min.

- **Acoustics and Hearing—**Bryde's whales produce low frequency tonal and swept calls similar to those of other rorquals (Oleson et al., 2003). Calls vary regionally, yet all but one of the call types have a fundamental frequency below 60 Hz. They last from one-quarter of a second to several seconds and are produced in extended sequences (Oleson et al., 2003). Heimlich et al. (2005) recently described five tone types. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat—**Bryde's whales are found both offshore and near the coasts in many regions. The Bryde's whale appears to have a preference for water temperatures between approximately 15° and 20°C (58 to 69°F) (Yoshida and Kato, 1999). Bryde's whales are more restricted to tropical and subtropical waters than other rorquals.

  General Distribution—Bryde's whales are found in subtropical and tropical waters and generally do not range north of 40° in the northern hemisphere or south of 40° in the southern hemisphere (Jefferson et al., 1993). The Bryde's whale does not have a well-defined breeding season in most areas and locations of specific breeding areas are unknown.

Occurrence in the Site A USWTR—There is a general lack of knowledge of this species, particularly in the North Atlantic, although records support a tropical occurrence for the species here (Mead, 1977). This species has been known to strand on the coasts of Georgia and eastern Florida (Schmidly, 1981). It is possible some of the sightings of unidentified rorquals recorded in the region may be of Bryde's whales. Bryde's whales may occur seaward of the shoreline year-round (DoN, 2008n). It is expected that Bryde's whales may occur in the Site A USWTR.

Sei Whale – Site A

- **General Description—**Adult sei whales are up to 18 m (59 ft) in length and are mostly dark gray in color with a lighter belly, often with mottling on the back (Jefferson et al., 1993). In the North Atlantic Ocean, the major prey species are copepods and krill (Kenney et al., 1985).

- **Status—**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). The sei whale is under the jurisdiction of the NMFS. A draft recovery plan for fin and sei whales was released in 1998 (NMFS, 1998a). It has since been determined that the two species should have separate recovery plans. The independent recovery plan for the sei whale has not yet been issued; however, the species is listed as endangered under the ESA.

- **Diving Behavior—**There are no reported diving depths or durations for sei whales.

- **Acoustics and Hearing—**Sei whales produce low frequency downswept vocalizations, averaging from 82 to 34 Hz over 1.4 seconds (Baumgartner et al., 2008). Sei whale vocalizations have been recorded only on a few occasions. Recordings from the North Atlantic consisted of paired sequences (0.5 to 0.8 s, separated by 0.4 to 1.0 s) of 10 to 20 short (4 milliseconds [ms]) FM sweeps between 1.5 and 3.5 kHz; source level was not known (Thomson and Richardson, 1995). These mid-frequency calls are distinctly different from low-frequency tonal and frequency swept calls recently recorded in the Antarctic; the average duration of the tonal calls was 0.45 ± 0.3 s, with an average frequency of 433 ± 192 Hz and a maximum source level of 156 ± 3.6 dB re 1 μPa (McDonald et al., 2005). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat—**Sei whales are most often found in deep, oceanic waters of the cool temperate zone. Sei whales appear to prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges (Kenney and Winn, 1987; Schilling et al., 1992; Gregr and Trites, 2001; Best and Lockyer, 2002). These areas are often the location of persistent hydrographic features, which may be important factors in concentrating prey, especially copepods. On the feeding grounds, the distribution is largely associated with oceanic frontal systems (Horwood, 1987). Characteristics of preferred breeding grounds are unknown. Horwood (1987) noted that sei whales prefer oceanic waters and are rarely found in marginal seas; historical whaling catches were usually from deepwater, and land station catches were usually taken from along or just off the edges of the continental shelf.

- **General Distribution—**Sei whales have a worldwide distribution but are found primarily in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood, 1987). Sei whales spend the summer months feeding in the subpolar higher latitudes and return to the lower latitudes to calve in the winter. For the most part, the location of winter breeding areas remains a mystery (Rice, 1998; Perry et al., 1999).

  In the western North Atlantic Ocean, the Nova Scotia Stock of the sei whale occurs primarily from Georges Bank north to Davis Strait (northeast Canada, between Greenland and Baffin Island; Perry et al., 1999). Peak abundance in U.S. waters occurs from winter through spring (mid-March through mid-June), primarily around the edges of Georges Bank (CETAP, 1982; Stimpert et al., 2003). The distribution of the Nova Scotia stock might extend along the U.S. coast at least to North Carolina (NMFS, 1998a).

  The hypothesis is that the Nova Scotia stock moves from spring feeding grounds on or near Georges Bank, to the Scotian Shelf in June and July, eastward to perhaps Newfoundland and the Grand Banks in late summer, then back to the

Scotian Shelf in fall, and offshore and south in winter (Mitchell and Chapman, 1977).

Occurrence in the Site A USWTR—The sei whale may occur rarely in Jacksonville OPAREA (including the Site A USWTR) during fall, winter, and spring due to the species' preference for deep, oceanic waters (waters with a bottom depth >2,000 m [6,500 ft]). Sei whales are not expected to occur in the OPAREA during the summer when they are on feeding grounds around the eastern Scotian Shelf or Grand Banks (Mitchell, 1975; Mitchell and Chapman, 1977). The sei whale is expected to occur only rarely in the deep water portions of Site A USWTR.

Fin Whale – Site A

- **General Description—**The fin whale is the second-largest whale species, with adults reaching 24 m (79 ft) in length (Jefferson et al., 1993). Fin whales feed by "gulping" upon a wide variety of small, schooling prey (especially herring, capelin, and sand lance) including squid and crustaceans (krill and copepods) (Kenney et al., 1985; NMFS, 2006l).

- **Status—**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 was incomplete. The fin whale is listed as endangered under the ESA and is managed under jurisdiction of the NMFS. The draft recovery plan for the fin whale was released in June 2006 (NMFS, 2006l). NMFS recently initiated a five-year review for the fin whale under the ESA (NMFS, 2007a).

- **Diving Behavior—**Fin whale dives are typically 5 to 15 min long and separated by sequences of four to five blows at 10- to 20-s intervals (CETAP, 1982; Stone et al., 1992; Lafortuna et al., 2003). Kopelman and Sadove (1995) found significant differences in blow intervals, dive times, and blows per hour between surface-feeding and non-surface-feeding fin whales. Croll et al. (2001b) determined that fin whales off the Pacific coast dived to a mean of 98 m (321 ft) (SD of ± 33 m [107 ft]) with a duration of 6.3 min (SD of ± 1.5 min) when foraging and to 59 m (195 ft) (SD of ± 30 m [97 ft]) with a duration of 4.2 min (SD of ± 1.7 min) when not foraging. Panigada et al. (1999) reported fin whale dives exceeding 150 m (492 ft) and coinciding with the diel migration of krill.

- **Acoustics and Hearing—**Fin and blue whales produce calls with the lowest frequency and highest source levels of all cetaceans. Infrasonic, pattern sounds have been documented for fin whales (Watkins et al., 1987; Clark and Fristrup, 1997; McDonald and Fox, 1999). Fin whales produce a variety of sounds with a frequency range up to 750 Hz. The long, patterned 15 to 30 Hz vocal sequence is most typically recorded; only males are known to produce these (Croll et al., 2002). The most typical fin whale sound is a 20 Hz infrasonic pulse (actually an

FM sweep from about 23 to 18 Hz) with durations of about 1 s and can reach source levels of 184 to 186 dB re 1 μPa (maximum up to 200; Watkins et al., 1987; Thomson and Richardson, 1995; Charif et al., 2002). Croll et al. (2002) recently suggested that these long, patterned vocalizations might function as male breeding displays, much like those that male humpback whales sing. The source depth, or depth of calling fin whales, has been reported to be about 50 m (164 ft) (Watkins et al., 1987). While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat—**The fin whale is found in continental shelf, slope, and oceanic waters. Off the U.S. east coast, the fin whale appears to be scarce in slope and Gulf Stream waters (CETAP, 1982; Waring et al., 1992). Waring et al. (1992) reported sighting fin whales along the edge of a warm core eddy and a remnant near Wilmington Canyon, along the northern wall of the Gulf Stream. Globally, this species tends to be aggregated in locations where populations of prey are most plentiful, irrespective of water depth, although those locations may shift seasonally or annually (Payne et al., 1986; 1990; Kenney et al., 1997; Notarbartolo-di-Sciara et al., 2003). Clark and Gagnon (2004) determined that vocalizing fin whales show strong preferences for shelf breaks, seamounts, or other areas where food resources are known to occur, even during summer months.

- **General Distribution—**Fin whales are broadly distributed throughout the world's oceans, including temperate, tropical, and polar regions (Jefferson et al., 2008). The overall range of fin whales in the North Atlantic extends from the Gulf of Mexico/Caribbean Sea and Mediterranean Sea north to Greenland, Iceland, and Norway (Gambell, 1985; NMFS, 1998a). In the western North Atlantic, the fin whale is the most commonly sighted large whale in continental shelf waters from the mid-Atlantic coast of the U.S. to eastern Canada (CETAP, 1982; Hain et al., 1992).

  Relatively consistent sighting locations for fin whales off the U.S. Atlantic coast include the banks on the Nova Scotian Shelf, Georges Bank, Jeffreys Ledge, Cashes Ledge, Stellwagen Bank, Grand Manan Bank, Newfoundland Grand Banks, the Great South Channel, the Gulf of St. Lawrence, off Long Island and Block Island, Rhode Island, and along the shelf break of the northeastern U.S. (CETAP, 1982; Hain et al., 1992; Waring et al., 2004). Hain et al. (1992) reported that the single most important habitat in their study was a region of the western Gulf of Maine, to Jeffreys Ledge, Cape Ann, Stellwagen Bank, and to the Great South Channel, in approximately 50 m (164 ft) of water. This was an area of high prey (sand lance) density during the 1970s and early 1980s (Kenney and Winn, 1986). Secondary areas of important fin whale habitat included the mid- to outer shelf from the northeast area of Georges Bank through the MAB.

Based on passive acoustic detection using Navy Sound Surveillance System (SOSUS) hydrophones in the western North Atlantic (Clark, 1995), fin whales are believed to move southward in the fall and northward in spring. The location and extent of the wintering grounds are poorly known (Aguilar, 2002). Fin whales have been seen feeding as far south as the coast of Virginia (Hain et al., 1992).

Fin whales are not completely absent from northeastern U.S. continental shelf waters in winter, indicating that not all members of the population conduct a full seasonal migration. Perhaps a fifth to a quarter of the spring/summer peak population remains in this area year-round (CETAP, 1982; Hain et al., 1992).

Peak calving is in October through January (Hain et al., 1992). However, location of breeding grounds is unknown.

Occurrence in the Site A USWTR— Fin whales are more commonly found north of Cape Hatteras (CETAP, 1982; Hain et al., 1992; Waring et al., 2007) than in the Jacksonville OPAREA. Fin whales may occur seaward of the shore in the Site A USWTR during the winter, spring, and fall (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 offshore of Florida.

Blue Whale – Site A

- **General Description—**Blue whales are the largest-living animals. Adult blue whales in the Northern Hemisphere reach 23 to 28 m (75 to 92 ft) in length (Jefferson et al., 1993). Blue whales, like other rorquals, feed by “gulping” (Pivorunas, 1979) almost exclusively on krill (Nemoto and Kawamura, 1977).

- **Status—**The endangered blue whale was severely depleted by commercial whaling in the twentieth century (NMFS, 1998b). At least two discrete populations are found in the North Atlantic. One ranges from West Greenland to New England and is centered in eastern Canadian waters; the other is centered in Icelandic waters and extends south to northwest Africa (Sears et al., 2005). There are no current estimates of abundance for the North Atlantic blue whale (Waring et al., 2008); however, the 308 photo-identified individuals from the Gulf of St. Lawrence area are considered to be a minimum population estimate for the western North Atlantic stock (Sears et al., 1987; Waring et al., 2008). The blue whale is under the jurisdiction of the NMFS. The recovery plan for the blue whale was issued in 1998 (NMFS, 1998b).

- **Diving Behavior—** Blue whales spend greater than 94 percent of their time below the water’s surface (Lagerquist et al., 2000). Croll et al. (2001a) determined that blue whales dived to an average of 140 m (459 ft) (S.D. of ± 46 m [152 ft]) and for 7.8 min (S.D. of ± 1.9 min) when foraging and to 68 m (222 ft) (S.D. of ± 51 m [169 ft]) and for 4.9 min (S.D. of ± 2.5 min) when not foraging. However, dives deeper than 300 m (984 ft) have been recorded from tagged individuals (Calambokidis et al., 2003).

- **Acoustics and Hearing—** Blue and fin whales produce calls with the lowest frequency and highest source levels of all cetaceans. Sounds are divided into two categories: short-duration or long duration. Blue whale vocalizations are typically long, patterned low-frequency sounds with durations up to 36 seconds (Thomson and Richardson, 1995) repeated every 1 to 2 min (Mellinger and Clark, 2003). Their frequency range is 12 to 400 Hz, with dominant energy in the infrasonic range at 12 to 25 Hz (Ketten, 1998; Mellinger and Clark, 2003). These long, patterned, infrasonic call series are sometimes referred to as "songs." The short-duration sounds are transient, frequency-modulated calls having a higher frequency range and shorter duration than song notes and often sweeping down in frequency (Di Iorio et al., 2005; Rankin et al., 2005). Short-duration sounds appear to be common; however, they are underrepresented in the literature (Rankin et al., 2005). These short-duration sounds are less than 5 seconds in duration (Di Iorio et al., 2005; Rankin et al., 2005) and are high-intensity, broadband (858±148 Hz) pulses (Di Iorio et al., 2005). Source levels of blue whale vocalizations are up to 188 dB re 1 μPa-m (Ketten, 1998; Moore, 1999; McDonald et al., 2001). During the Magellan II Sea Test (at-sea exercises designed to test systems for antisubmarine warfare) off the coast of California in 1994, blue whale vocalization source levels at 17 Hz were estimated in the range of 195 dB re 1 μPa-m (Aburto et al., 1997). Vocalizations of blue whales appear to vary among geographic areas (Rivers, 1997), with clear differences in call structure suggestive of separate populations for the western and eastern regions of the North Pacific (Stafford et al., 2001). Blue whale sounds in the North Atlantic have been confirmed to have different characteristics (i.e., frequency, duration, and repetition) than those recorded in other parts of the world (Mellinger and Clark, 2003; Berchok et al., 2006). Stafford et al. (2005) recorded the highest calling rates when blue whale prey was closest to the surface during its vertical migration. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

- **Habitat—**Blue whales inhabit both coastal and oceanic waters in temperate and tropical areas (Yochem and Leatherwood, 1985). Blue whales in the Atlantic are primarily found in deeper, offshore waters and are rare in shallow, shelf waters (Wenzel et al., 1988). Important foraging areas for this species include the edges of continental shelves and upwelling regions (Reilly and Thayer, 1990; Schoenherr, 1991). Based on acoustic and tagging data from the North Pacific, relatively cold, productive waters and fronts attract feeding blue whales (e.g., Moore et al., 2002). In the Gulf of St. Lawrence, blue whales show strong preferences for the nearshore regions where strong tidal and current mixing leads to high productivity and rich prey resources (Sears et al., 1990). Clark and Gagnon (2004) determined that vocalizing blue whales show strong preferences for shelf breaks, sea mounts, or other areas where food resources are known to occur, even during summer months.

- **General Distribution—**Blue whales are distributed from the ice edge to the tropics and subtropics in both hemispheres (Jefferson et al., 1993). Stranding and sighting data suggest that the blue whale's original range in the Atlantic extended south to Florida, the Gulf of Mexico, however the southern limit of this species' range is unknown (Yochem and Leatherwood, 1985). Blue whales rarely occur in the U.S. Atlantic EEZ and the Gulf of Maine from August to October, which may represent the limits of their feeding range (CETAP, 1982; Wenzel et al., 1988). Researchers using Navy Integrated Undersea Surveillance System (IUSS) resources have more recently been able to detect blue whales throughout the open Atlantic south to at least The Bahamas (Clark, 1995; Clark and Gagnon, 2004) suggesting that all North Atlantic blue whales may comprise a single stock (NMFS, 1998a).

  Calving occurs primarily during the winter (Yochem and Leatherwood, 1985; Jefferson et al., 2008). Breeding grounds are thought to be located in tropical/subtropical waters; however exact locations are unknown (Jefferson et al., 2008).

Occurrence in the Site A USWTR— Blue whales may occur rarely in the Jacksonville OPAREA (including the Site A USWTR) during fall, winter, and spring due to their preference for deep oceanic waters (waters with a bottom depth >2,000 m [6,560 ft]). Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Blue whales are not expected to occur in the Site A area during summer when they are likely farther north in their feeding ranges.

Odontocetes

Following is a general discussion of the distribution of odontocete species that may occur in the Jacksonville OPAREA in the vicinity of Site A.

Sperm Whale – Site A

- **General Description—**The sperm whale is the largest toothed whale species. Adult females can reach 12 m (39 ft) in length, while adult males measure as much as 18 m (59 ft) in length (Jefferson et al., 1993). Sperm whales prey on mesopelagic squids and other cephalopods, as well as demersal fishes and benthic invertebrates (Rice, 1989; Clarke, 1996).

- **Status—**Sperm whales are classified as endangered under the ESA (NMFS, 2006d), although they are globally not in any immediate danger of extinction. 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). The sperm whale is under the jurisdiction of the NMFS. The draft recovery plan for the sperm whale was released in June 2006 for public comment (NMFS, 2006m). In January 2007, NMFS initiated a five-year review for the sperm whale under the ESA (NMFS, 2007d).

- **Diving Behavior—**Sperm whales forage during deep dives that routinely exceed a depth of 400 m (1,312 ft) and a duration of 30 minutes (Watkins et al., 2002). They are capable of diving to depths of over 2,000 m (6,562 ft) with durations of over 60 minutes (Watkins et al., 1993). Sperm whales spend up to 83 percent of daylight hours underwater (Jaquet et al., 2000; Amano and Yoshioka, 2003). Males do not spend extensive periods of time at the surface (Jaquet et al., 2000). In contrast, females spend prolonged periods of time at the surface (1 to 5 hr daily) without foraging (Whitehead and Weilgart, 1991; Amano and Yoshioka, 2003). An average dive cycle consists of about a 45-min dive with a 9-min surface interval (Watwood et al., 2006). The average swimming speed is estimated to be 2.5 km/hr (1.3 NM/hr) (Watkins et al., 2002). Dive descents for tagged individuals average 11 min at a rate of 1.52 m/s (2.95 kt), and ascents average 11.8 min at a rate of 5.5 km/hr (3 NM/hr) (Watkins et al., 2002).

- **Acoustics and Hearing—**Sperm whales typically produce short-duration (less than 30 ms), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges (Thomson and Richardson, 1995). When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill, 1977). The different types of codas have been associated with specific behavioral contexts (Frantzis and Alexadou, 2008). Codas are shared between individuals of a social unit and are considered to be primarily for intragroup communication (Weilgart and Whitehead, 1997; Rendell and Whitehead, 2004). Recent research in the South Pacific suggests that in breeding areas the majority of codas are produced by mature females (Marcoux et al., 2006). Coda repertoires have also been found to vary geographically and are categorized as dialects, similar to those of killer whales (Weilgart and Whitehead, 1997; Pavan et al., 2000). For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean and those in the Pacific (Weilgart and Whitehead, 1997). Furthermore, the clicks of neonatal sperm whales are very different from those of adults. Neonatal clicks are of low-directionality, long-duration (2 to 12 ms), low-frequency (dominant frequencies around 0.5 kHz) with estimated source levels between 140 and 162 dB re 1 μPa rms, and are hypothesized to function in communication with adults (Madsen et al., 2003a). Source levels from adult sperm whales' highly directional (possible echolocation), short (100 microseconds [μs]) clicks have been estimated up to 236 dB re 1 μPa rms (Møhl et al., 2003). Creaks (rapid sets of clicks) are heard most-frequently when sperm whales are engaged in foraging behavior in the deepest portion of their dives with intervals between clicks and source levels being altered during these behaviors (Miller et al., 2004; Laplanche et al., 2005). It has been shown that sperm whales may produce clicks during 81 percent of their dive period, specifically 64 percent of the time during their descent phases (Watwood et al., 2006). In addition to producing clicks, sperm whales in some regions like Sri Lanka and the Mediterranean Sea have been recorded making what are called trumpets at the beginning of dives just before commencing click production (Teloni, 2005). The estimated source level of one of these low intensity sounds (trumpets) was estimated to be 172 dB re 1 μPa (Teloni et al., 2005).

The anatomy of the sperm whale's inner and middle ear indicates an ability to best hear high-frequency to ultrasonic frequency sounds. They may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten, 1992). The auditory brainstem response (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).

- **Habitat—**Sperm whale distribution can be variable, but is generally associated with waters over the continental shelf edge, continental slope, and offshore (CETAP, 1982; Hain et al., 1985; Smith et al., 1996; Waring et al., 2001; Davis et al., 2002). Rice (1989) noted a strong offshore preference by sperm whales.

  In some areas, sperm whale densities have been correlated with high secondary productivity and steep underwater topography (Jaquet and Whitehead, 1996). Data from the Gulf of Mexico suggest that sperm whales adjust their movements to stay in or near cold-core rings (Davis et al., 2000, 2002), which demonstrate that sperm whales can shift their movements in response to prey density.

  Off the eastern U.S., sperm whales are found in regions of pronounced horizontal temperature gradients, such as along the edges of the Gulf Stream and within warm-core rings (Waring et al., 1993; Jaquet et al., 1996; Griffin, 1999). Fritts et al. (1983) reported sighting sperm whales associated with the Gulf Stream. Waring et al. (2003) conducted a deepwater survey south of Georges Bank in 2002 and examined fine-scale habitat use by sperm whales. Sperm whales were located in waters characterized by sea-surface temperatures of 23° to 25°C (73° to 77°F) and bottom depths of 325 to 2,300 m (1,066 to 7,546 ft) (Waring et al., 2003).

- **General Distribution—**Sperm whales are found from tropical to polar waters in all oceans of the world between approximately 70°N and 70°S (Rice, 1998).

Females are normally restricted to areas with SST greater than approximately 15°C (59°F), whereas males, and especially the largest males, can be found in waters as far poleward as the pack ice with temperatures close to 0°C (32°F) (Rice, 1989). The thermal limits of female distribution correspond approximately to the 40° parallel (50° in the North Pacific) (Whitehead, 2003).

Sperm whales are the most-frequently sighted whales seaward of the continental shelf off the eastern U.S. (CETAP, 1982; Kenney and Winn, 1987; Waring et al., 1993; Waring et al., 2007). In Atlantic EEZ waters, sperm whales appear to have a distinctly seasonal distribution (CETAP, 1982; Scott and Sadove, 1997; Waring et al., 2007). Although concentrations shift depending on the season, sperm whales are generally distributed in Atlantic EEZ waters year-round.

Mating may occur December through August, with the peak breeding season falling in the spring (NMFS, 2006m); however location of specific breeding grounds is unknown.

Occurrence in the Site A USWTR— Sperm whales may occur year-round seaward of the shelf break throughout the Jacksonville OPAREA. The sperm whale is expected in the vicinity of Site A USWTR, particularly in areas around the shelf break and seaward.

Pygmy and Dwarf Sperm Whales – Site A

- **General Description—**Dwarf and pygmy sperm whales are difficult for the inexperienced observer to distinguish from one another at sea, and sightings of either species are often categorized as *Kogia* spp. The difficulty in identifying pygmy and dwarf sperm whales is exacerbated by their avoidance reaction towards ships and change in behavior towards approaching survey aircraft (Würsig et al., 1998). Pygmy and dwarf sperm whales reach body lengths of around 3 and 2.5 m (8 and 10 ft), respectively (Plön and Bernard, 1999). *Kogia* spp. feed on cephalopods and, less often, on deep-sea fish and shrimp (Caldwell and Caldwell, 1989; McAlpine et al., 1997; Willis and Baird, 1998; Santos et al., 2006).

- **Status—**There is currently no information to differentiate Atlantic stock(s) (Waring et al., 2008). The best estimate of abundance for both species combined in the western North Atlantic is 395 individuals (Waring et al., 2008). Species-level abundance estimates cannot be calculated due to uncertainty of species identification at sea (Waring et al., 2008). Pygmy and dwarf sperm whales are under the jurisdiction of NMFS.

- **Diving Behavior—**Willis and Baird (1998) reported that whales of the genus *Kogia* make dives of up to 25 min. Dive times ranging from 15 to 30 min (with 2 min surface intervals) have been recorded for a dwarf sperm whale in the Gulf of

California (Breese and Tershy, 1993). Median dive times of around 11 min are documented for *Kogia* (Barlow, 1999). A satellite-tagged pygmy sperm whale released off Florida was found to make long nighttime dives, presumably indicating foraging on squid in the deep scattering layer (DSL) (Scott et al., 2001). Most sightings of *Kogia* are brief; these whales are often difficult to approach and they sometimes actively avoid aircraft and vessels (Würsig et al., 1998).

- **Acoustics and Hearing—**There is little published information on sounds produced by *Kogia* spp., although they are categorized as non-whistling smaller toothed whales. Recently, free-ranging dwarf sperm whales off La Martinique (Lesser Antilles) were recorded producing clicks at 13 to 33 kHz with durations of 0.3 to 0.5 s (Jérémie et al., 2006). The only sound recordings for the pygmy sperm whale are from two stranded individuals. A stranded individual being prepared for release in the western North Atlantic emitted clicks of narrowband pulses with a mean duration of 119 μs, interclick intervals between 40 and 70 ms, centroid frequency of 129 kHz, peak frequency of 130 kHz, and apparent source level of up to 175 dB re 1 μPa peak-to-peak (Madsen et al., 2005). Another individual found stranded in Monterey Bay produced echolocation clicks ranging from 60 to 200 kHz, with a dominant frequency of 120 to 130 kHz (Ridgway and Carder, 2001).

  No information on sound production or 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).

- **Habitat—***Kogia* spp. occur in waters along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). Data from the Gulf of Mexico suggest that *Kogia* spp. may associate with frontal regions along the continental shelf break and upper continental slope, where higher epipelagic zooplankton biomass may enhance the densities of squids, their primary prey (Baumgartner et al., 2001).

- **General Distribution—**Both *Kogia* species apparently have a worldwide distribution in tropical and temperate waters (Jefferson et al., 1993). In the western Atlantic Ocean, stranding records have documented the pygmy sperm whale as far north as the northern Gulf of St. Lawrence, New Brunswick and parts of eastern Canada (Piers, 1923, Measures et al., 2004; McAlpine et al., 1997; Baird et al., 1996) and as far south as Colombia and around to Brazil (in the southern Atlantic) (de Carvalho, 1967; Geise and Borobia, 1987; Muñoz-Hincapié et al., 1998). Pygmy sperm whales are also found in the Gulf of Mexico (Hysmith, 1976; Gunter et al., 1955; Baumgartner et al., 2001) and in the Caribbean (MacLeod and Hauser, 2002).

The northern range of the dwarf sperm whale is largely unknown; however, multiple stranding records exist on the eastern coast of the U.S. as far north as North Carolina (Hohn et al., 2006) and Virginia (Morgan et al., 2002; Potter, 1979). Records of strandings and incidental captures indicate the dwarf sperm whale may range as far south as the Northern Antilles in the northern Atlantic (Muñoz-Hincapié et al., 1998); although records continue south along Brazil in the southern Atlantic (Muñoz-Hincapié et al., 1998). Dwarf sperm whales occur in the Caribbean (Caldwell et al., 1973; Cardona-Maldonado and Mignucci-Giannoni, 1999) and the Gulf of Mexico (Davis et al., 2002; Jefferson and Schiro, 1997).

Births have been recorded between December and March for dwarf sperm whales in South Africa (Plön, 2004), however, the breeding season and specific locations in the northwest Atlantic are unknown. Seasonality and location of pygmy sperm whale breeding is unknown.

<u>Occurrence in the Site A USWTR</u>—*Kogia* spp. generally occur along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). *Kogia* spp. are expected to occur seaward of the shelf break throughout Site A year-round. Few sightings are recorded in the Jacksonville OPAREA, which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall), as well as their avoidance reactions towards ships. Strandings are recorded near the Jacksonville OPAREA during all seasons and support the likelihood of *Kogia* occurrence in the region year-round (DoN, 2008n). *Kogia* spp. may occur seaward of the shelf break throughout the Jacksonville OPAREA vicinity year-round and are expected in this region in the Site A USWTR.

Beaked Whales – Site A

Based upon available data, the following five beaked whale species may be affected by the proposed activities in the Site A area: Cuvier's beaked whales and four members of the genus *Mesoplodon* (True's, Gervais', Blainville's, and Sowerby's beaked whales).

- **General Description—**Cuvier's beaked whales are relatively robust compared to other beaked whale species. Male and female Cuvier's beaked whales may reach 7.5 and 7.0 m (25 and 23 ft) in length, respectively (Jefferson et al., 1993). *Mesoplodon* species have maximum reported adult lengths of 6.2 m (20 ft) (Mead, 1989). Stomach content analyses of captured and stranded individuals suggest beaked whales are deep divers that feed by suction on mesopelagic fishes, squids, and deepwater benthic invertebrates (Heyning, 1989; Heyning and Mead, 1996; Santos et al., 2001; MacLeod et al., 2003). Stomach contents of Cuvier's beaked whales rarely contain fishes, while stomach contents of *Mesoplodon* species frequently do (MacLeod et al., 2003).

- **Status—**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). A recent study of global phylogeographic structure of Cuvier's beaked whales suggested that some regions show a high level of differentiation (Dalebout et al., 2005); however, Dalebout et al., (2005) could not discern finer-scale population differences within the North Atlantic. Beaked whales are under the jurisdiction of NMFS.

- **Diving Behavior—**Dives range from those near the surface where the animals are still visible to long, deep dives. Dive durations for *Mesoplodon* spp. are typically over 20 min (Barlow, 1999; Baird et al., 2005). Tagged northern bottlenose whales off Nova Scotia were found to dive approximately every 80 min to over 800 m (2,625 ft), with a maximum dive depth of 1,453 m (4,764 ft) for as long as 70 min (Hooker and Baird, 1999). Northern bottlenose whale dives fall into two discrete categories: short-duration (mean of 12 min), shallow dives and long-duration (mean of 37 min), deep dives (Hooker and Baird, 1999). Tagged Cuvier's beaked whale dive durations as long as 87 min and dive depths of up to 1,990 m (6,529 ft) have been recorded (Baird et al., 2004; Baird et al., 2005). Tagged Blainville's beaked whale dives have been recorded to 1,408 m (4,619 ft) and lasting as long as 54 min (Baird et al., 2005). Baird et al. (2005) reported that several aspects of diving were similar between Cuvier's and Blainville's beaked whales: (1) both dove for 48 to 68 min to depths greater than 800 m (2,625 ft), with one long dive occurring on average every 2 hr; (2) ascent rates for long/deep dives were substantially slower than descent rates, while during shorter dives there were no consistent differences; and (3) both spent prolonged periods of time (66 to 155 min) in the upper 50 m (164 ft) of the water column. Both species make a series of shallow dives after a deep foraging dive to recover from oxygen debt; average intervals between foraging dives have been recorded as 63 min for Cuvier's beaked whales and 92 min for Blainville's beaked whales (Tyack et al., 2006).

- **Acoustics and Hearing—**Sounds recorded from beaked whales are divided into two categories: whistles and pulsed sounds (clicks); whistles likely serve a communicative function and pulsed sounds are important in foraging and/or navigation (Johnson et al., 2004; Madsen et al., 2005) (MacLeod and D'Amico, 2006; Tyack et al., 2006). Whistle frequencies are about 2 to 12 kHz, while pulsed sounds range in frequency from 300 Hz to 135 kHz; however, as noted by MacLeod and D'Amico (2006), higher frequencies may not be recorded due to equipment limitations. Whistles recorded from free-ranging Cuvier's beaked whales off Greece ranged in frequency from 8 to 12 kHz, with an upsweep of about 1 s (Manghi et al., 1999), while pulsed sounds had a narrow peak frequency of 13 to 17 kHz, lasting 15 to 44 s in duration (Frantzis et al., 2002). Short whistles and chirps from a stranded subadult Blainville's beaked whale ranged in frequency from slightly less than 1 to almost 6 kHz (Caldwell and Caldwell, 1971a).

Recent studies incorporating D-tags (miniature sound and orientation recording tag) attached to Blainville's beaked whales in the Canary Islands and Cuvier's beaked whales in the Ligurian Sea recorded high-frequency echolocation clicks (duration: 175 μs for Blainville's and 200 to 250 μs for Cuvier's) with dominant frequency ranges from about 20 to over 40 kHz (limit of recording system was 48 kHz) and only at depths greater than 200 m (656 ft) (Johnson et al., 2004; Madsen et al., 2005; Zimmer et al., 2005; Tyack et al., 2006). The source level of the Blainville's beaked whales' clicks were estimated to range from 200 to 220 dB re 1 μPa peak-to-peak (Johnson et al., 2004), while they were 214 dB re 1 μPa peak-to-peak for the Cuvier's beaked whale (Zimmer et al., 2005).

From anatomical examination of their ears, it is presumed that beaked whales are predominantly adapted to best hear ultrasonic frequencies (MacLeod, 1999; Ketten, 2000). Beaked whales have well-developed semi-circular canals (typically for vestibular function but may function differently in beaked whales) compared to other cetacean species, and they may be more sensitive than other cetaceans to low-frequency sounds (MacLeod, 1999; Ketten, 2000). Ketten (2000) remarked on how beaked whale ears (computerized tomography [CT] scans of Cuvier's, Blainville's, Sowerby's, and Gervais' beaked whale heads) have anomalously well-developed vestibular elements and heavily reinforced (large bore, strutted) Eustachian tubes and noted that they may impart special resonances and acoustic sensitivities. 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).

- **Habitat—**World-wide, beaked whales normally inhabit continental slope and deep oceanic waters (>200 m [656 ft]) (Waring et al., 2001; Cañadas et al., 2002; Pitman, 2002; MacLeod et al., 2004; Ferguson et al., 2006; MacLeod and Mitchell, 2006). Beaked whales are only occasionally reported in waters over the continental shelf (Pitman, 2002). Distribution of *Mesoplodon* spp. in the North Atlantic may relate to water temperature (MacLeod, 2000b). The Blainville's and Gervais' beaked whales occur in warmer southern waters, in contrast to Sowerby's and True's beaked whales that are more northern (MacLeod, 2000a). Beaked whale abundance off the eastern U.S. may be highest in association with the Gulf Stream and the warm-core rings it develops (Waring et al., 1992). In summer, the continental shelf break off the northeastern U.S. is primary habitat (Waring et al., 2001).

- **General Distribution—**Cuvier's beaked whales are the most widely-distributed of the beaked whales and are present in most regions of all major oceans

(Heyning, 1989; MacLeod et al., 2006). This species occupies almost all temperate, subtropical, and tropical waters, as well as subpolar and even polar waters in some areas (MacLeod et al., 2006). Blainville's beaked whales are thought to have a continuous distribution throughout tropical, subtropical, and warm-temperate waters of the world's oceans; they occasionally occur in cold-temperate areas (MacLeod et al., 2006). The Gervais' beaked whale is restricted to warm-temperate and tropical Atlantic waters with records throughout the Caribbean Sea (MacLeod et al., 2006). The Sowerby's beaked whale is endemic to the North Atlantic; this is considered to be more of a temperate species (MacLeod et al., 2006). In the western North Atlantic, confirmed strandings of True's beaked whales are recorded from Nova Scotia to Florida and also in Bermuda (MacLeod et al., 2006). There is also a sighting made southeast of Hatteras Inlet, North Carolina (note that the latitude provided by Tove is incorrect) (Tove, 1995).

The continental shelf margins from Cape Hatteras to southern Nova Scotia were recently identified as known "key areas" for beaked whales in a global review by MacLeod and Mitchell (2006). Beaked whale life histories are poorly known, reproductive biology is generally not described, and the locations of specific breeding grounds are unknown.

Occurrence in the Site A USWTR—Cuvier's, True's, Gervais', and Blainville's beaked whales are the only beaked whale species that may occur in the Jacksonville 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 Jacksonville 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 isobath (6,560 ft) (DoN, 2008l, m).

Rough-toothed Dolphin – Site A

- **General Description—**The rough-toothed dolphin is relatively robust with a cone-shaped head with no demarcation between the melon and beak (Jefferson et al., 1993). Rough-toothed dolphins reach 2.8 m (9.2 ft) in length (Jefferson et al., 1993). They feed on cephalopods and fish, including large fish such as dorado (Miyazaki and Perrin, 1994; Reeves et al., 1999; Pitman and Stinchcomb, 2002).

- **Status—**No abundance estimate is available for rough-toothed dolphins in the western North Atlantic (Waring et al., 2008). The rough-toothed dolphin is under the jurisdiction of NMFS.

- **Diving Behavior—**Rough-toothed dolphins may stay submerged for up to 15 min (Miyazaki and Perrin, 1994) and are known to dive as deep as 150 m (492 ft) (Manire and Wells, 2005).

- **Acoustics and Hearing—**The rough-toothed dolphin produces a variety of sounds, including broadband echolocation clicks and whistles. Echolocation clicks (duration less than 250 μs) typically have a frequency range of 0.1 to 200 kHz, with a dominant frequency of 25 kHz (Miyazaki and Perrin, 1994; Yu et al., 2003; Chou, 2005). Whistles (duration less than 1 s) have a wide frequency range of 0.3 to greater than 24 kHz but dominate in the 2 to 14 kHz range (Miyazaki and Perrin, 1994; Yu et al., 2003).

  Auditory evoked potential (AEP) measurements were performed on six individuals involved in a mass stranding event on Hutchinson Island, Florida in August 2004 (Cook et al., 2005). The rough-toothed dolphin can detect sounds between 5 and 80 kHz and is most likely capable of detecting frequencies much higher than 80 kHz (Cook et al., 2005).

- **Habitat—**The rough-toothed dolphin is regarded as an offshore species that prefers deep waters; however, it can occur in shallower waters as well (e.g., Gannier and West, 2005). Tagging data for this species from the Gulf of Mexico and western North Atlantic provide important information on habitat preferences. Three dolphins with satellite-linked transmitters released in 1998 off the Gulf Coast of Florida were tracked off the Florida panhandle in average water depths of 195 m (640 ft) (Wells et al., 1999). Dolphins released in March of 2005 after a mass stranding were tagged with satellite-linked transmitters and released southeast of Fort Pierce moved within the Gulf Stream and parallel to the continental shelf off Florida, Georgia, and South Carolina, in waters with a depth of 400 to 800 m (1,312 to 2,625ft) ((Manire and Wells, 2005). They later moved northeast into waters with a depth greater than 4,000 m (13,120 ft) (Manire and Wells, 2005). Another tagged dolphin released after the 2005 mass stranding moved north as far as Charleston, South Carolina, before returning to the Miami area, remaining in relatively shallow waters (Wells, 2007). During May 2005, seven more rough-toothed dolphins (stranded in the Florida Keys in March 2005 and rehabilitated) were tagged and released by the Marine Mammal Conservancy in the Florida Keys (Wells, 2007). During an initial period of apparent disorientation in the shallow waters west of Andros Island, they continued to the east, then moved north through Crooked Island Passage, and paralleled the West Indies (Wells, 2007). The last signal placed them northeast of the Lesser Antilles (Wells, 2007). During September 2005, two more individuals (from the same mass stranding) were satellite-tagged and released east of the Florida Keys and proceeded south to a deep trench close to the north coast of Cuba (Wells, 2007).

- **General Distribution—**Rough-toothed dolphins are found in tropical to warm-temperate waters globally, rarely ranging north of 40°N or south of 35°S (Miyazaki and Perrin, 1994). This species is not a commonly encountered species in the areas where it is known to occur (Jefferson, 2002). Not many records for this species exist from the western North Atlantic, but they indicate that this species occurs from Virginia south to Florida, the Gulf of Mexico, the West Indies, and along the northeastern coast of South America (Leatherwood et al., 1976; Jefferson et al., 2008). Seasonality and location of rough-toothed dolphin breeding is unknown.

<u>Occurrence in the Site A USWTR</u>— Occurrence is expected seaward of the shelf break throughout the Jacksonville OPAREA based on this species' preference for deep waters (DoN, 2008n). Rough-toothed dolphins are expected seaward of the shelf break in the Site A USWTR.

Bottlenose Dolphin – Site A

- **General Description—**Bottlenose dolphins are large and robust with striking regional variations in body size; adult body lengths range from 1.9 to 3.8 m (6.2 to 12.5 ft) (Jefferson et al., 1993). Bottlenose dolphins are opportunistic feeders that utilize numerous feeding strategies to prey upon a variety of fish, cephalopods, and shrimp (Shane, 1990; Wells and Scott, 1999).

- **Status—**Two forms of bottlenose dolphins are recognized in the western North Atlantic Ocean: nearshore (coastal) and offshore (Waring et al., 2008). The best estimate for the western North Atlantic coastal stock of bottlenose dolphins is 15,620 (Waring et al., 2008). Currently, a single western North Atlantic offshore stock is recognized seaward of 34 km (18NM) from the U.S. coastline (Waring et al., 2008). The best population estimate for this stock is 81,588 individuals (Waring et al., 2008).

- **Diving Behavior—**Dive durations as long as 15 min are recorded for trained individuals (Ridgway et al., 1969). Typical dives, however, are more shallow and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 s at shallow depths (Mate et al., 1995) and can last longer than 5 min during deep offshore dives (Klatsky et al., 2005). Offshore bottlenose dolphins regularly dive to 450 m (1,476 ft) and possibly as deep as 700 m (2,297 ft) (Klatsky et al., 2005). Bottlenose dolphin dive behavior may correlate with diel cycles (Mate et al., 1995; Klatsky et al., 2005); this may be especially true for offshore stocks, which have dive deeper and more frequently at night to feed upon the deep scattering layer (Klatsky et al., 2005).

- **Acoustics and Hearing—**Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks and whistles have a dominant frequency range of 110 to 130 kHz and a source level of 218 to 228 dB re 1 μPa (Au, 1993) and 3.4 to 14.5 kHz and 125 to 173 dB re 1 μPa, respectively (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Caldwell and Caldwell, 1965; Janik et al., 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook et al., 2004). Sound production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fishes, specifically sea trout (*Salmo trutta*) and Atlantic salmon (*Salmo salar*), in some regions (i.e., Moray Firth, Scotland) (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutiérrez and Stienessen, 2004; Cook et al., 2004). Furthermore, both whistles and clicks have been demonstrated to vary geographically in terms of overall vocal activity, group size, and specific context (e.g., feeding, milling, traveling, and socializing) (Jones and Sayigh, 2002; Zaretsky et al., 2005; Baron, 2006). For example, preliminary research indicates that characteristics of whistles from populations in the northern Gulf of Mexico significantly differ (i.e., in frequency and duration) from those in the western north Atlantic (Zaretsky et al., 2005; Baron, 2006).

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at the some lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Threshold shifts refer to shifts in the ability to detect sound within certain acoustic ranges due to a marine mammal's exposure to sound. Temporary threshold shifts (TTS) in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (i.e., broad-band, pulses) (DoN, 1997b; Schlundt et al., 2000; Nachtigall et al., 2003; Finneran et al., 2005; Mooney et al., 2005; Mooney, 2006). For example, TTS has been induced with exposure to a 3 kHz, 1-s pulse with sound exposure level (SEL) of 195 dB referenced to 1 micropascal squared second (dB re 1 μPa^2-s) (Finneran et al., 2005), one-second pulses from 3 to 20 kHz at 192 to 201 dB re 1μPa (Schlundt et al., 2000), and octave band noise (4 to 11 kHz) for 50 min at 179 dB re 1 μPa (Nachtigall et al., 2003). Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). Observed changes in behavior were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa (DoN, 1997b; Schlundt et al., 2000). Finneran et al. (2005) concluded that a SEL of 195 dB re 1 μPa^2-s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

- **Habitat—**Coastal bottlenose dolphins occur in coastal embayments and estuaries as well as in waters over the continental shelf; individuals may exhibit either resident or migratory patterns in coastal areas (Kenney, 1990). Bays, sounds, and estuaries are high-use habitats for bottlenose dolphins due to their importance as nursery and feeding areas (Read et al., 2003).

  Coastal bottlenose dolphins show a temperature-limited distribution, occurring in significantly warmer waters than the offshore stock, and having a distinct northern boundary (Kenney, 1990). A study of the Chesapeake Bay/Virginia coast area showed a much greater probability of sightings with SSTs of 16° to 28°C (61° to 82°F) (Armstrong et al., 2005). SST may significantly influence seasonal movements of migrating coastal dolphins along the western Atlantic coast (Barco et al., 1999); these seasonal movements are likely also influenced by movements of prey resources.

  In the western North Atlantic, the greatest concentrations of the offshore stock are along the continental shelf break (Kenney, 1990). Evidence suggests that there is a distinct spatial separation of the coastal and offshore stocks during the summer; however the morphotypes overlap in the winter (Garrison et al., 2003; Torres et al., 2003). During CETAP surveys, offshore bottlenose dolphins generally were distributed between the 200 and 2,000-m (656 and 6,560-ft) isobaths in waters with a mean bottom depth of 846 m (2,776 ft) from Cape Hatteras to the eastern end of Georges Bank. Geography and temperature also influence the distribution of offshore bottlenose dolphins (Kenney, 1990).

- **General Distribution—**In the western North Atlantic, bottlenose dolphins occur as far north as Nova Scotia but are most common in coastal waters from New England to Florida, the Gulf of Mexico, the Caribbean, and southward to Venezuela and Brazil (Würsig et al., 2000). Bottlenose dolphins occur seasonally in estuaries and coastal embayments as far north as Delaware Bay (Kenney, 1990) and in waters over the outer continental shelf and inner slope, as far north as Georges Bank (CETAP, 1982; Kenney, 1990).

  Populations exhibit seasonal migrations regulated by temperature and prey availability (Torres et al., 2005), traveling as far north as New Jersey in summer and as far south as central Florida in winter (Urian et al., 1999) .

Coastal bottlenose dolphins along the western Atlantic coast may exhibit either resident or migratory patterns (Waring et al., 2008). Photo-identification studies support evidence of year-round resident bottlenose dolphin populations in Beaufort and Wilmington, North Carolina (Koster et al., 2000); these are the northernmost documented sites of year-round residency for bottlenose dolphins in the western North Atlantic (Koster et al., 2000). Migratory dolphins may enter these areas seasonally as well, as evidenced by a bottlenose dolphin tagged in 2001 in Virginia Beach who overwintered in waters between Cape Hatteras and Cape Lookout (NMFS-SEFSC, 2001a).

Bottlenose dolphins are flexible in their timing of reproduction. Seasons of birth for bottlenose dolphin populations are likely responses to seasonal patterns of availability of local resources (Urian et al., 1996). There are no specific breeding locations for this species.

Occurrence in the Site A USWTR —Bottlenose dolphins are abundant in continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring et al., 2008). The greatest concentrations of offshore animals are along the continental shelf break and between the 200- and 2,000-m (656 and 6,560-ft) isobaths (Kenney, 1990; Waring et al, 2008); however, tagging data suggest that the range of offshore bottlenose dolphins may actually extend further offshore into much deeper waters (Wells et al., 1999). Bottlenose dolphins occur throughout the Jacksonville OPAREA vicinity year-round, in both coastal and deep offshore waters. During a NMFS-SEFSC survey of the area south of Maryland to central Florida, Mullin and Fulling (2003) reported sighting bottlenose dolphins throughout the study area, but primarily in or near continental shelf waters. Bottlenose dolphins are expected throughout Site A USWTR.

Atlantic Spotted Dolphin – Site A

- **General Description—**Atlantic spotted dolphin adults are up to 2.3 m (7.5 ft) long and can weigh as much as 143 kg (315 lbs) (Jefferson et al., 1993). Atlantic spotted dolphins are born spotless and develop spots as they age (Perrin et al., 1994a; Herzing, 1997). There is marked regional variation in the adult body size of the Atlantic spotted dolphin (Perrin et al., 1987). There are two forms: a robust, heavily spotted form that inhabits the continental shelf, usually found within 250 to 350 km (135 to 189 NM) of the coast and a smaller, less-spotted form that inhabits offshore waters (Perrin et al., 1994a). Atlantic spotted dolphins feed on small cephalopods, fish, and benthic invertebrates (Perrin et al., 1994a).

- **Status—**The best estimate of Atlantic spotted dolphin abundance in the western North Atlantic is 50,978 individuals (Waring et al., 2008). Recent genetic evidence suggests that there are at least two populations in the western North Atlantic (Adams and Rosel, 2006), as well as possible continental shelf and offshore segregations. Atlantic populations are divided along a latitudinal boundary corresponding roughly to Cape Hatteras (Adams and Rosel, 2006). The Atlantic spotted dolphin is under the jurisdiction of NMFS.

- **Diving Behavior—**The only information on diving depth for this species is from a satellite-tagged individual in the Gulf of Mexico (Davis et al., 1996). This individual made short, shallow dives to less than 10 m (33 ft) and as deep as 60 m (197 ft), while in waters over the continental shelf on 76 percent of dives.

- **Acoustics and Hearing—**A variety of sounds including whistles, echolocation clicks, squawks, barks, growls, and chirps have been recorded for the Atlantic spotted dolphin (Thomson and Richardson, 1995). Whistles have dominant frequencies below 20 kHz (range: 7.1 to 14.5 kHz) but multiple harmonics extend above 100 kHz, while burst pulses consist of frequencies above 20 kHz (dominant frequency of approximately 40 kHz) (Lammers et al., 2003). Other sounds, such as squawks, barks, growls, and chirps, typically range in frequency from 0.1 to 8 kHz (Thomson and Richardson, 1995). Recently recorded echolocation clicks have two dominant frequency ranges at 40 to 50 kHz and 110 to 130 kHz, depending on source level (i.e., lower source levels typically correspond to lower frequencies and higher frequencies to higher source levels (Au and Herzing, 2003). Echolocation click source levels as high as 210 dB re 1 µPa peak-to-peak have been recorded (Au and Herzing, 2003). Spotted dolphins in The Bahamas were frequently recorded during agonistic/aggressive interactions with bottlenose dolphins (and their own species) to produce squawks (0.2 to 12 kHz broad band burst pulses; males and females), screams (5.8 to 9.4 kHz whistles; males only), barks (0.2 to 20 kHz burst pulses; males only), and synchronized squawks (0.1-15 kHz burst pulses; males only in a coordinated group) (Herzing, 1996).

  There has been no data collected on Atlantic spotted dolphin hearing ability. However, odontocetes are generally adapted to hear high-frequencies (Ketten, 1997).

- **Habitat—**Atlantic spotted dolphins occupy both continental shelf and offshore habitats. The large, heavily-spotted coastal form typically occurs over the continental shelf within or near the 185 m (607 ft) isobath, 8 to 20 km (4 to 11 NM) from shore (Perrin et al., 1994a; Davis et al., 1998; Perrin, 2002b). There are also frequent sightings beyond the continental shelf break in the Caribbean Sea, Gulf of Mexico, and off the U.S. Atlantic Coast (Mills and Rademacher, 1996; Roden and Mullin, 2000; Fulling et al., 2003; Mullin and Fulling, 2003; Mullin et al., 2004). Atlantic spotted dolphins are found commonly in inshore waters south of Chesapeake Bay as well as over continental shelf break and slope waters north of this region (Payne et al., 1984; Mullin and Fulling, 2003). Sightings have also been made along the northern wall of the Gulf Stream and its associated warm-core ring features (Waring et al., 1992).

- **General Distribution—**Atlantic spotted dolphins are distributed in warm-temperate and tropical Atlantic waters from approximately 45°N to 35°S; in the western North Atlantic, this translates to waters from northern New England to Venezuela, including the Gulf of Mexico and the Caribbean Sea (Perrin et al., 1987).

  Peak calving periods in the Bahamas are early spring and late fall (Herzing, 1997). However, in the western Atlantic breeding times and locations are largely unknown.

Occurrence in the Site A USWTR— Atlantic spotted dolphins may occur in both continental shelf and offshore waters of the Jacksonville OPAREA year-round. Atlantic spotted dolphins regularly occur in waters over the continental shelf and slope (Payne et al., 1984; Mullin and Fulling, 2003). The Gulf Stream and its associated warm-core ring features likely influence occurrence of this species in this region. Atlantic spotted dolphins are expected throughout Site A USWTR

Pantropical Spotted Dolphin – Site A

- **General Description—**The pantropical spotted dolphin is a rather slender dolphin. Adults may reach 2.6 m (8.5 ft) in length (Jefferson et al., 1993). Pantropical spotted dolphins are born spotless and develop spots as they age although the degree of spotting varies geographically (Perrin and Hohn, 1994). North and offshore of Cape Hatteras, adults may bear only a few small, dark, ventral spots whereas individuals over the continental shelf become so heavily spotted that they appear nearly white (Perrin and Hohn, 1994). Pantropical spotted dolphins prey on epipelagic fish, squid, and crustaceans (Perrin and Hohn, 1994; Robertson and Chivers, 1997; Wang et al., 2003).

- **Status—**The best estimate of abundance of the western North Atlantic stock of pantropical spotted dolphins is 4,439 individuals (Waring et al., 2008). There is no information on stock differentiation for pantropical spotted dolphins in the U.S. Atlantic (Waring et al., 2008). The pantropical spotted dolphin is under the jurisdiction of NMFS.

- **Diving Behavior—**Dives during the day generally are shorter and shallower than dives at night; rates of descent and ascent are higher at night than during the day (Baird et al., 2001). Similar mean dive durations and depths have been obtained for tagged pantropical spotted dolphins in the eastern tropical Pacific and off Hawaii (Baird et al., 2001).

- **Acoustics and Hearing—**Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz (Thomson and Richardson, 1995). Clicks typically have two frequency peaks (bimodal) at 40 to 60 kHz and 120 to 140 kHz with estimated source levels up to 220 dB re 1 μPa peak-to-peak (Schotten et al., 2004). No direct measures of hearing ability are available for pantropical spotted dolphins, but ear anatomy has been studied and indicates that this species should be adapted to hear the lower range of ultrasonic frequencies (less than 100 kHz) (Ketten, 1992; 1997).

- **Habitat—**Pantropical spotted dolphins tend to associate with bathymetric relief and oceanographic interfaces. Pantropical spotted dolphins may rarely be sighted in shallower waters (e.g., Peddemors, 1999; Gannier, 2002; Mignucci-Giannoni et al., 2003; Waring et al., 2007). Along the northeastern U.S., Waring et al. (1992) found that *Stenella* spp. were distributed along the Gulf Stream's northern wall. *Stenella* sightings also occurred within the Gulf Stream, which is consistent with the oceanic distribution of this genus and its preference for warm water (Waring et al., 1992; Mullin and Fulling, 2003).

- **General Distribution—**Pantropical spotted dolphins occur in subtropical and tropical waters worldwide (Perrin and Hohn, 1994).

  In the eastern tropical Pacific, where this species has been best studied, there are two (possibly three) calving peaks: one in spring, (one possibly in summer), and one in fall (Perrin and Hohn, 1994). However, in the western Atlantic breeding times and locations are largely unknown.

<u>Occurrence in the Site A USWTR</u>— Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring et al., 2008). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Based on sighting data and known habitat preferences, pantropical spotted dolphins may occur seaward of the shelf break throughout the Jacksonville OPAREA year-round. Pantropical spotted dolphins are expected to occur in waters seaward of the shelf break in the Site A USWTR.

Spinner Dolphin – Site A

- **General Description—**The spinner dolphin generally has a dark eye-to-flipper stripe and dark lips and beak tip (Jefferson et al., 1993). This species typically has a three-part color pattern (dark gray cape, light gray sides, and white belly). Adults can reach 2.4 m (7.8 ft) in length (Jefferson et al., 1993). Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp (Perrin and Gilpatrick, 1994).

- **Status—**No abundance estimates are currently available for the western North Atlantic stock of spinner dolphins (Waring et al., 2008). Stock structure in the western North Atlantic is unknown (Waring et al., 2008). The spinner dolphin is under the jurisdiction of NMFS.

- **Diving Behavior—**Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp, and they dive to at least 200 to 300 m (656 to 984 ft) (Perrin and Gilpatrick, 1994). Foraging takes place primarily at night when the mesopelagic community migrates vertically towards the surface and also horizontally towards the shore at night (Benoit-Bird et al., 2001; Benoit-Bird and Au, 2004). Rather than foraging offshore for the entire night, spinner dolphins track the horizontal migration of their prey (Benoit-Bird and Au, 2003). This tracking of the prey allows spinner dolphins to maximize their foraging time while foraging on the prey at its highest densities (Benoit-Bird and Au, 2003; Benoit-Bird, 2004).

  Spinner dolphins are well known for their propensity to leap high into the air and spin before landing in the water; the purpose of this behavior is unknown. Norris and Dohl (1980) also described several other types of aerial behavior, including several other leap types, backslaps, headslaps, noseouts, tailslaps, and a behavior called "motorboating." Undoubtedly, spinner dolphins are one of the most aerially active of all dolphin species.

- **Acoustics and Hearing—** Pulses, whistles, and clicks have been recorded from spinner dolphins. Pulses have a frequency range of 1 to 160 kHz, while whistles have been recorded between 1 to 25 kHz (Ketten, 1998; Lammers et al., 2003). Spinner dolphins consistently produce whistles with frequencies as high as 16.9 to 17.9 kHz with a maximum frequency for the fundamental component at 24.9 kHz (Bazúa-Durán and Au, 2002; Lammers et al., 2003). Clicks have a dominant frequency of 60 kHz (Ketten, 1998). The burst pulses are predominantly ultrasonic, often with little or no energy below 20 kHz (Lammers et al., 2003). Source levels between 195 and 222 dB re 1 μPa peak-to-peak have been recorded for spinner dolphin clicks (Schotten et al., 2004). There are no data available on the hearing of spinner dolphins.

- **Habitat—**Spinner dolphins occur in both oceanic and coastal environments. Most sightings of this species have been associated with inshore waters, islands, or banks (Perrin and Gilpatrick, 1994). Spinner dolphin distribution in the Gulf of Mexico and off the northeastern U.S. coast is primarily in offshore waters. Along the northeastern U.S. and Gulf of Mexico, they are distributed in waters with a bottom depth greater than 2,000 m (6,562 ft) (CETAP, 1982; Davis et al., 1998). Off the eastern U.S. coast, spinner dolphins were sighted within the Gulf Stream, which is consistent with the oceanic distribution and warm-water preference of this genus (Waring et al., 1992).

- **General Distribution—**Spinner dolphins are found in subtropical and tropical waters worldwide, with different geographical forms in various ocean basins. The range of this species extends to near 40° latitude (Jefferson et al., 1993). Distribution in the western North Atlantic is thought to extend from North Carolina south to Venezuela (Schmidly, 1981), including the Gulf of Mexico (Davis et al., 2002).

  Breeding occurs across all season with calving peaks that may range from late spring to fall for different populations (Jefferson et al., 2008); however location of breeding areas is unknown.

Occurrence in the Site A USWTR—Spinner dolphins may occur seaward of the vicinity of the continental shelf break in the Jacksonville OPAREA based on known preference for deep, warm waters, and the distribution of the few confirmed records for this species in the area (DoN, 2008n). In the Site A USWTR, spinner dolphins are expected to occur near the shelf break and in deep waters seaward of the shelf break year-round.

Clymene Dolphin – Site A

- **General Description—**Due to similarity in appearance, Clymene dolphins are easily confused with spinner and short-beaked common dolphins (Fertl et al., 2003). The Clymene dolphin, however, is smaller and more robust, with a much shorter and stockier beak. The Clymene dolphin can reach 2 m (6.6 ft) in length and weights of 85 kg (187 lbs) (Jefferson et al., 1993). Clymene dolphins feed on small pelagic fish and squid (Perrin et al., 1981; Perrin and Mead, 1994; Fertl et al., 1997).

- **Status—**The population in the western North Atlantic is currently considered a separate stock for management purposes although there is not enough information to distinguish this stock from the Gulf of Mexico stock(s) (Waring et al., 2008). The best estimate of abundance for the western North Atlantic stock of Clymene dolphins is 6,086 individuals (Waring et al., 2008). The Clymene dolphin is under NMFS jurisdiction.

- **Diving Behavior—**There is no diving information available for this species.

- **Acoustics and Hearing—**The only data available for this species is a description of their whistles. 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) (Mullin et al., 1994a).

  There is no empirical data on the hearing ability of Clymene dolphins; however, the most sensitive hearing range for odontocetes generally includes high frequencies (Ketten, 1997).

- **Habitat—**Clymene dolphins are a tropical to subtropical species, primarily sighted in deep waters well beyond the edge of the continental shelf (Fertl et al., 2003). Biogeographically, the Clymene dolphin is found in the warmer waters of the North Atlantic from the North Equatorial Current, the Gulf Stream, and the Canary Current (Fertl et al., 2003). In the western North Atlantic, Clymene dolphins were identified primarily in offshore waters east of Cape Hatteras over the continental slope and are likely to be strongly influenced by oceanographic features of the Gulf Stream (Mullin and Fulling, 2003).

- **General Distribution—**In the western Atlantic Ocean, Clymene dolphins are distributed from New Jersey to Brazil, including the Gulf of Mexico and Caribbean Sea (Fertl et al., 2003; Moreno et al., 2005). Seasonality and location of Clymene dolphin breeding is unknown.

Occurrence in the Site A USWTR—Clymene dolphins have been found stranded along the Atlantic coast of Florida adjacent to the OPAREA and further south throughout the year (Caldwell and Caldwell, 1975; Perrin et al., 1981; Fertl et al., 2003). Based on confirmed sightings and the preference of this species for deep waters, Clymene dolphins are expected in waters seaward of the shelf break in the Jacksonville OPAREA throughout the year. Clymene dolphins are expected in waters seaward of the shelf break in the Site A USWTR.

Striped Dolphin – Site A

- **General Description—**The striped dolphin is uniquely marked with black lateral stripes from eye to flipper and eye to anus. There is also a light gray spinal blaze originating above and behind the eye and narrowing below and behind the dorsal fin (Jefferson et al., 2008).This species reaches 2.6 m (8.5 ft) in length. Small, mid-water fishes (in particular, myctophids or lanternfish) and squids are the dominant prey (Perrin et al., 1994b; Ringelstein et al., 2006).

- **Status—**The best estimate of striped dolphin abundance in the western North Atlantic is 94,462 individuals (Waring et al., 2008). The striped dolphin is under the jurisdiction of NMFS.

- **Diving Behavior—**Striped dolphins often feed in pelagic or benthopelagic zones along the continental slope or just beyond it in oceanic waters. A majority of their prey possesses luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 200 to 700 m (656 to 2,297 ft) to reach potential prey (Archer II and Perrin, 1999). Striped dolphins may feed at night in order to take advantage of the deep scattering layer's diurnal vertical movements.

- **Acoustics and Hearing—**Striped dolphin whistles range from 6 to greater than 24 kHz, with dominant frequencies ranging from 8 to 12.5 kHz (Thomson and Richardson, 1995). A single striped dolphin's hearing range, determined by using standard psycho-acoustic techniques, was from 0.5 to 160 kHz with best sensitivity at 64 kHz (Kastelein et al., 2003).

- **Habitat—**Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters and are often associated with convergence zones and waters influenced by upwelling (Au and Perryman, 1985). This species also occurs in conjunction with the shelf edge in the northeastern U.S. (between Cape Hatteras and Georges Bank; Hain et al., 1985). Striped dolphins are known to associate with the Gulf Stream's northern wall and warm-core ring features (Waring et al., 1992).

- **General Distribution—**Striped dolphins are distributed worldwide in cool-temperate to tropical zones. In the western North Atlantic, this species occurs from Nova Scotia southward to the Caribbean Sea, Gulf of Mexico, and Brazil (Baird et al., 1993; Jefferson et al., 2008). Off the northeastern U.S., striped dolphins are distributed along the continental shelf break from Cape Hatteras to the southern margin of Georges Bank, as well as offshore over the continental slope and continental rise in the mid-Atlantic region (CETAP, 1982).

  Off Japan, where their biology has been best studied, there are two calving peaks: one in summer and one in winter (Perrin et al., 1994b). However, in the western Atlantic breeding times and locations are largely unknown.

<u>Occurrence in the Site A USWTR</u>**—** Based on sparse available data, striped dolphins may sporadically occur near and seaward of the shelf break throughout the Jacksonville OPAREA year-round. Striped dolphins may occur rarely in the vicinity of the shelf break within the Site A USWTR.

Common Dolphin – Site A

- **General Description—**Only the short-beaked common dolphin is expected to occur in the Action Area. The short-beaked common dolphin is a moderately-robust dolphin, with a moderate-length beak, and a tall, slightly falcate dorsal fin. Length ranges up to about 2.3 m (7.5 ft) (females) and 2.6 m (8.5 ft) (males); however, there is substantial geographic variation (Jefferson et al., 1993). Common dolphins feed on a wide variety of epipelagic and mesopelagic schooling fish and squid, such as the long-finned squid, Atlantic mackerel, herring, whiting, pilchard, and anchovy (Waring et al., 1990; Overholtz and Waring, 1991).

- **Status—**The best estimate of abundance for the Western North Atlantic *Delphinus* spp. stock is 120,743 individuals (Waring et al., 2008). There is no information available for western North Atlantic common dolphin stock structure (Waring et al., 2008). The common dolphin is under the jurisdiction of NMFS.

- **Diving Behavior—**Diel fluctuations in vocal activity of this species (more vocal activity during late evening and early morning) appear to be linked to feeding on the deep scattering layer as it rises (Goold, 2000). Foraging dives up to 200 m (656 ft) in depth have been recorded off southern California (Evans, 1994).

- **Acoustics and Hearing—**Recorded *Delphinus* spp. vocalizations include whistles, chirps, barks, and clicks (Ketten, 1998). Clicks range from 0.2 to 150 kHz with dominant frequencies between 23 and 67 kHz and estimated source levels of 170 dB re 1 μPa. Chirps and barks typically have a frequency range from less than 0.5 to 14 kHz, and whistles range in frequency from 2 to 18 kHz (DoN, 1976; Thomson and Richardson, 1995; Ketten, 1998; Oswald et al., 2003). Maximum source levels are approximately 180 dB re 1 μPa (DoN, 1976). This species' hearing range extends from 10 to 150 kHz; sensitivity is greatest from 60 to 70 kHz (Popov and Klishin, 1998).

- **Habitat—**Common dolphins occupy a variety of habitats, including shallow continental shelf waters, waters along the continental shelf break, and continental slope and oceanic areas. Along the U.S. Atlantic coast, common dolphins typically occur in temperate waters on the continental shelf between the 100 and 200 m (328 and 656 ft) isobaths, but can occur in association with the Gulf Stream (CETAP, 1982; Selzer and Payne, 1988; Waring and Palka, 2002).

- **General Distribution—**Common dolphins occur from southern Norway to West Africa in the eastern Atlantic and from Newfoundland to Florida in the western Atlantic (Perrin, 2002a), although this species more commonly occurs in temperate, cooler waters in the northwestern Atlantic (Waring and Palka, 2002). This species is abundant within a broad band paralleling the continental slope from 35°N to the northeast peak of Georges Bank (Selzer and Payne, 1988). Short-beaked common dolphin sightings are known to occur primarily along the continental shelf break south of 40°N in spring and north of this latitude in fall. During fall, this species is particularly abundant along the northern edge of Georges Bank (CETAP, 1982) but less common south of Cape Hatteras (Waring et al., 2008).

  Calving peaks differ between stocks, and have been reported in spring and autumn as well as in spring and summer (Jefferson et al., 1993). However, locations of breeding areas are unknown.

<u>Occurrence in the Site A USWTR</u>—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 Jacksonville 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.

Fraser's Dolphin – Site A

- **General Description—**The Fraser's dolphin reaches a maximum length of 2.7 m (8.9 ft) and is generally more robust than other small delphinids (Jefferson et al., 1993). They feed on mesopelagic fish, squid, and shrimp (Jefferson and Leatherwood, 1994; Perrin et al., 1994a).

- **Status—**No abundance estimate of Fraser's dolphins in the western North Atlantic is available (Waring et al., 2008). Fraser's dolphins are under the jurisdiction of NMFS.

- **Diving Behavior—**There is no information available on depths to which Fraser's dolphins may dive, but they are thought to be capable of deep diving.

  Acoustics and Hearing—Fraser's dolphin whistles have been recorded having a frequency range of 7.6 to 13.4 kHz in the Gulf of Mexico (duration less than 0.5 s) (Leatherwood et al., 1993). There are no empirical hearing data available for this species.

- **Habitat—**The Fraser's dolphin is an oceanic species, except in places where deepwater approaches a coastline (Dolar, 2002).

- **General Distribution—**Fraser's dolphins are found in subtropical and tropical waters around the world, typically between 30°N and 30°S (Jefferson et al., 1993). Few records are available from the Atlantic Ocean (Leatherwood et al., 1993; Watkins et al., 1994; Bolaños and Villarroel-Marin, 2003). Location of Fraser's dolphin breeding is unknown, and available data do not support calving seasonality.

<u>Occurrence in the Site A USWTR</u>—Although there are no confirmed records of Fraser's dolphins in the Jacksonville OPAREA, the most likely area of occurrence in the study area is in waters beyond the shelf break; distribution is assumed to be similar year-round. Fraser's dolphins may occur seaward of the shelf break in the Site A USWTR.

Risso's Dolphin – Site A

- **General Description—**Risso's dolphins are moderately large, robust animals reaching at least 3.8 m (12.5 ft) in length (Jefferson et al., 1993). Cephalopods are their primary prey (Clarke, 1996).

- **Status—**The best estimate of Risso's dolphin abundance in the western North Atlantic is 20,479 individuals (Waring et al., 2008). Risso's dolphins are under the jurisdiction of NMFS.

- **Diving Behavior—**Individuals may remain submerged on dives for up to 30 min and dive as deep as 600 m (1,967 ft) (DiGiovanni et al., 2005).

- **Acoustics and Hearing—**Risso's dolphin vocalizations include broadband clicks, barks, buzzes, grunts, chirps, whistles, and combined whistle and burst-pulse sounds that range in frequency from 0.4 to 22 kHz and in duration from less than a second to several seconds (Corkeron and Van Parijs, 2001). The combined whistle and burst pulse sound (2 to 22 kHz, mean duration of 8 s) appears to be unique to Risso's dolphin (Corkeron and Van Parijs, 2001). Risso's dolphins also produce echolocation clicks (40 to 70 μs duration) with a dominant frequency range of 50 to 65 kHz and estimated source levels up to 222 dB re 1 μPa peak-to-peak (Thomson and Richardson, 1995; Philips et al., 2003; Madsen et al., 2004b).

  Baseline research on the hearing ability of this species was conducted by Nachtigall et al. (1995) in a natural setting (included natural background noise) using behavioral methods on one older individual. This individual could hear frequencies ranging from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. Recently, the auditory brainstem response technique has been used to measure hearing in a stranded infant (Nachtigall et al., 2005). This individual could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz. This study demonstrated that this species can hear higher frequencies than previously reported.

- **Habitat—**Several studies have noted that Risso's dolphins are found offshore, along the continental slope, and over the continental shelf (CETAP, 1982; Green et al., 1992; Baumgartner, 1997; Davis et al., 1998; Mignucci-Giannoni, 1998; Kruse et al., 1999). Baumgartner (1997) hypothesized that the fidelity of Risso's dolphins on the steeper portions of the upper continental slope in the Gulf of Mexico is most likely the result of cephalopod prey distribution in the same area.

- **General Distribution—**Risso's dolphins are distributed worldwide in cool-temperate to tropical waters from roughly 60°N to 60°S, where SSTs are generally greater than 10°C (50ºF) (Kruse et al., 1999). In the western North Atlantic, this species is found from Newfoundland (Jefferson et al., 2008) southward to the Gulf of Mexico (Baumgartner, 1997; Jefferson and Schiro, 1997), throughout the Caribbean, and around the equator (van Bree, 1975; Ward et al., 2001).

  Risso's dolphins are distributed along the continental shelf break and slope waters from Cape Hatteras north to Georges Bank in spring, summer, and fall (CETAP, 1982; Payne et al., 1984). In the winter the range shifts to MAB and offshore waters (Payne et al., 1984). Risso's dolphins may also occur in the waters from the mid-shelf to over the slope from Georges Bank south to, and including, the MAB, primarily in the summer and fall (Payne et al., 1984). Only rare occurrences are noted in the Gulf of Maine (Payne et al., 1984). In the North Atlantic, there appears to be a summer calving peak (Jefferson et al., 1993); however locations of breeding areas are unknown.

Occurrence in the Site A USWTR— Risso's dolphins may occur seaward of just inshore of the shelf break in the Jacksonville OPAREA based on sighting data and the preference of this species for deep waters. Risso's dolphins are expected in the vicinity of the shelf break and seaward year-round in the Site A USWTR.

Melon-headed Whale – Site A

- **General Description—**Melon-headed whales at sea closely resemble pygmy killer whales; both species have blunt heads with little or no beak. Melon-headed whales have pointed (versus rounded) flippers and a more triangular head shape than pygmy killer whales (Jefferson et al., 1993). Melon-headed whales reach a maximum length of 2.8 m (9.0 ft) (Jefferson et al., 1993). Melon-headed whales prey on squid, pelagic fish, and occasionally crustaceans. Most fish and squid prey are mesopelagic in waters up to 1,500 m (4,921 ft) deep, suggesting that feeding takes place deep in the water column (Jefferson and Barros, 1997).

- **Status—**There are no abundance estimates for melon-headed whales in the western North Atlantic (Waring et al., 2008). The melon-headed whale is under the jurisdiction of NMFS.

- **Diving Behavior—**Melon-headed whales prey on squids, pelagic fishes, and occasionally crustaceans. Most fish and squid prey are mesopelagic in waters up to 1,500 m (4,921 ft) deep, suggesting that feeding takes place deep in the water column (Jefferson and Barros, 1997). There is no information on specific diving depths for melon-headed whales.

- **Acoustics and Hearing—**The only published acoustic information for melon-headed whales is from the southeastern Caribbean (Watkins et al., 1997). Sounds recorded included whistles and click sequences. Recorded whistles have dominant frequencies between 8 and 12 kHz; higher-level whistles were estimated at no more than 155 dB re 1 μPa (Watkins et al., 1997). Clicks had dominant frequencies of 20 to 40 kHz; higher-level click bursts were judged to be about 165 dB re 1 μPa (Watkins et al., 1997). No empirical data on hearing ability for this species are available.

- **Habitat—**Melon-headed whales are most often found in offshore waters. Sightings off Cape Hatteras, North Carolina are reported in waters greater than 2,500 m (8,200 ft) (Waring et al., 2008), and most in the Gulf of Mexico have been well beyond the edge of the continental shelf break (Mullin et al., 1994; Davis and Fargion, 1996a; Davis et al., 2000) and out over the abyssal plain (Waring et al., 2004). Nearshore sightings are generally from areas where deep, oceanic waters approach the coast (Perryman, 2002).

  General Distribution—Melon-headed whales occur worldwide in subtropical and tropical waters. There are very few records for melon-headed whales in the North Atlantic (Ross and Leatherwood, 1994; Jefferson and Barros, 1997). Maryland is thought to represent the extreme of the northern distribution for this species in the northwest Atlantic (Perryman et al., 1994; Jefferson and Barros, 1997). Seasonality and location of melon-headed whale breeding are unknown.

Occurrence in the Site A USWTR—The melon-headed whale is an oceanic species. Strandings have been recorded along the Florida coastline (DoN, 2008n). Based on the low number of confirmed sightings of this species along the Atlantic U.S. coast and the melon-headed whale's propensity for warmer and deeper waters, melon-headed whales may occur seaward of the shelf break in the Jacksonville OPAREA. Therefore, the melon-headed whale may occur rarely in the deep water portion of Site A USWTR.

Pygmy Killer Whale – Site A

- **General Description—**The pygmy killer whale is often confused with the melon-headed whale and less often with the false killer whale. Flipper shape is the best distinguishing characteristic; pygmy killer whales have rounded flipper tips (Jefferson et al., 1993). Pygmy killer whales reach lengths of up to 2.6 m (8.5 ft) (Jefferson et al., 1993). Pygmy killer whales eat predominantly fishes and squids, and sometimes take large fish. They are known to occasionally attack other dolphins (Perryman and Foster, 1980; Ross and Leatherwood, 1994).

- **Status—**There are no abundance estimates for pygmy killer whales in the western North Atlantic (Waring et al., 2008). Pygmy killer whales are under the jurisdiction of NMFS.

- **Diving Behavior—**There is no diving information available for this species.

- **Acoustics and Hearing—**The pygmy killer whale emits short duration, broadband signals similar to a large number of other delphinid species (Madsen et al., 2004b). Clicks produced by pygmy killer whales have centroid frequencies (i.e., the frequency at which the energy in the click is divided into two equal portions) between 70 and 85 kHz; there are bimodal peak frequencies between 45 and 117 kHz. The estimated source levels are between 197 and 223 dB re 1 μPa peak-to-peak (Madsen et al., 2004b). These clicks possess characteristics of echolocation clicks (Madsen et al., 2004b). There are no empirical hearing data available for this species.

- **Habitat—**Pygmy killer whales generally occupy offshore habitats. In the northern Gulf of Mexico, this species is found primarily in deeper waters off the continental shelf (Davis and Fargion, 1996b; Davis et al., 2000) out to waters over the abyssal plain (Jefferson, 2006). Pygmy killer whales were sighted in waters deeper than 1,500 m (4,921 ft) off Cape Hatteras (Hansen et al., 1994).

  General Distribution—Pygmy killer whales have a worldwide distribution in tropical and subtropical waters, generally not ranging north of 40°N or south of 35°S (Jefferson et al., 1993). There are few records of this species in the western North Atlantic (e.g., Caldwell and Caldwell, 1971; Ross and Leatherwood, 1994). Most records from outside the tropics are associated with unseasonable intrusions of warm water into higher latitudes (Ross and Leatherwood, 1994). Seasonality and location of pygmy killer whale breeding are unknown.

<u>Occurrence in the Site A USWTR</u>—A sighting of six individuals is confirmed in the vicinity of the Jacksonville OPAREA (Hansen et al., 1994). There are also a few strandings to the south (Caldwell and Caldwell, 1975; Schmidly, 1981). The pygmy killer whale is an oceanic species; occurrence is expected seaward of the shelf break year-round throughout the Jacksonville OPAREA. Pygmy killer whales may occur in the deep water portions of Site A USWTR.

False Killer Whale – Site A

- **General Description—**The false killer whale has a long slender body, a rounded overhanging forehead, and little or no beak (Jefferson et al., 1993). Individuals reach maximum lengths of 6.1 m (20 ft) (Jefferson et al., 1993). The flippers have a characteristic hump on the S-shaped leading edge—this is perhaps the best characteristic for distinguishing this species from the other “blackfish” (an informal grouping that is often taken to include pygmy killer, melon-headed, and pilot whales; Jefferson et al., 1993). Deepwater cephalopods and fishes are their primary prey (Odell and McClune, 1999), but large pelagic species, such as dorado, have been taken. False killer whales are known to attack marine mammals such as other delphinids, (Perryman and Foster, 1980; Stacey and Baird, 1991), sperm whales (Palacios and Mate, 1996), and baleen whales (Hoyt, 1983; Jefferson, 2006).

- **Status—**There are no abundance estimates available for this species in the western North Atlantic (Waring et al., 2008). The false killer whale is under the jurisdiction of NMFS.

- **Diving Behavior—**Few diving data are available, although individuals are documented to dive as deep as 500 m (1,640 ft) (Odell and McClune, 1999). Shallower dive depths (maximum of 53 m [174 ft]; averaging from 8 to 12 m [26 to 39 ft]) have been recorded for false killer whales in Hawaiian waters.

- **Acoustics and Hearing—**Dominant frequencies of false killer whale whistles are from 4 to 9.5 kHz, and those of their echolocation clicks are from either 20 to 60 kHz or 100 to 130 kHz depending on ambient noise and target distance (Thomson and Richardson, 1995). Click source levels typically range from 200 to 228 dB re 1 µPa-m (Ketten, 1998). Recently, false killer whales recorded in the Indian Ocean produced echolocation clicks with dominant frequencies of about 40 kHz and estimated source levels of 201-225 dB re 1 µPa-m peak-to-peak (Madsen et al., 2004b).

  False killer whales can hear frequencies ranging from approximately 2 to 115 kHz, with their best hearing sensitivity ranging from 16 to 64 kHz (Thomas et al., 1988). Additional behavioral audiograms of false killer whales support a narrower range of best hearing sensitivity between 16 and 24 kHz, with peak sensitivity at 20 kHz (Yuen et al., 2005). The same study also measured audiograms using the ABR technique, which came to similar results, with a range of best hearing sensitivity between 16 and 22.5 kHz, peaking at 22.5 kHz (Yuen et al., 2005). Behavioral audiograms in this study consistently resulted in lower thresholds than those obtained by ABR.

- **Habitat—**False killer whales are primarily offshore animals, although they do come close to shore, particularly around oceanic islands (Baird, 2002). Inshore movements are occasionally associated with movements of prey and shoreward flooding of warm ocean currents (Stacey et al., 1994).

- **General Distribution—**False killer whales are found in tropical and temperate waters, generally between 50°S and 50°N latitude with a few records north of 50°N in the Pacific and the Atlantic (Baird et al., 1989; Odell and McClune, 1999). Seasonality and location of false killer whale breeding are unknown.

Occurrence in the Site A USWTR—False killer whales occur in offshore, warm waters worldwide (Baird, 2002). The warm waters of the Gulf Stream are likely to influence their occurrence in the Action Area. Occurrence is expected seaward of the shelf break throughout the Jacksonville OPAREA year-round. The false killer whale is expected in waters of the Site A USWTR location that are seaward of the shelf break.

Killer Whale – Site A

- **General Description—**Killer whales are probably the most instantly recognizable of all the cetaceans. The black-and-white color pattern of the killer whale is striking, as is the tall, erect dorsal fin of the adult male (1.0 to 1.8 m [3.3 to 5.9 ft] in height). This is the largest member of the dolphin family. Females may reach 7.7 m (25 ft) in length and males 9.0 m (30 ft) (Dahlheim and Heyning, 1999). Killer whales feed on fish, cephalopods, seabirds, sea turtles, and other marine mammals (Katona et al., 1988; Jefferson et al., 1991; Jefferson et al., 2008).

- **Status—**There are no estimates of abundance for killer whales in the western North Atlantic (Waring et al., 2008). Most cetacean taxonomists agree that multiple killer whale species or subspecies occur worldwide (Krahn et al., 2004; Waples and Clapham, 2004). However, at this time, further information is not available, particularly for the western North Atlantic. The killer whale is under the jurisdiction of NMFS.

- **Diving Behavior—**The maximum recorded depth for a free-ranging killer whale dive was 264 m (866 ft) off British Columbia (Baird et al., 2005). A trained killer whale dove to 260 m (853 ft) (Dahlheim and Heyning, 1999). The longest duration of a recorded dive was 17 min (Dahlheim and Heyning, 1999); however, shallower dives were much more common for eight tagged individuals, where less than three percent of all dives examined were greater than 30 m (98 ft) in depth (Baird et al., 2003).

- **Acoustics and Hearing—**Killer whales produce a wide variety of clicks and whistles, but most of this species' social sounds are pulsed, with frequencies ranging from 0.5 to 25 kHz (dominant frequency range: 1 to 6 kHz) (Thomson and Richardson, 1995). Echolocation clicks recorded for Canadian killer whales foraging on salmon have source levels ranging from 195 to 224 dB re 1 μPa peak-to-peak, a center frequency ranging from 45 to 80 kHz, and durations of 80 to 120 μs (Au et al., 2004). Echolocation clicks from Norwegian killer whales were considerably lower than the previously mentioned study and ranged from 173 to 202 dB re 1 μPa peak-to-peak. The clicks had a center frequency ranging from 22 to 49 kHz and durations of 31 to 203 μs (Simon et al., 2007). Source levels associated with social sounds have been calculated to range from 131 to 168 dB re 1 μPa and have been demonstrated to vary with vocalization type (e.g., whistles: average source level of 140.2 dB re 1 μPa, variable calls: average source level of 146.6 dB re 1 μPa, and stereotyped calls: average source level 152.6 dB re 1 μPa) (Veirs, 2004). Additionally, killer whales modify their vocalizations depending on social context or ecological function (i.e., short-range vocalizations [less than 10 km {5 NM} range] are typically associated with social and resting behaviors and long-range vocalizations [10 to 16 km {5 to 9 NM} range] are associated with travel and foraging) (Miller, 2006). Likewise, echolocation clicks are adapted to the type of fish prey (Simon et al., 2007).

  Acoustic studies of resident killer whales in British Columbia have found that they possess dialects, which are highly stereotyped, repetitive discrete calls that are group-specific and are shared by all group members (Ford, 2002). These dialects likely are used to maintain group identity and cohesion and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford, 1991; 2002). Dialects have been documented in northern Norway (Ford, 2002) and southern Alaskan killer whales populations (Yurk et al., 2002) and are likely occur in other regions as well. Both behavioral and ABR techniques indicate killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz, which is one of the lowest maximum-sensitivity frequency known among toothed whales (Szymanski et al., 1999).

- **Habitat—**Killer whales have the most ubiquitous distribution of any species of marine mammal, and they have been observed in virtually every marine habitat from the tropics to the poles and from shallow, inshore waters (and even rivers) to deep, oceanic regions (Dahlheim and Heyning, 1999). In coastal areas, killer whales often enter shallow bays, estuaries, and river mouths (Leatherwood et al., 1976). Based on a review of historical sighting and whaling records, killer whales in the northwestern Atlantic are found most often along the shelf break and further offshore (Katona et al., 1988; Mitchell and Reeves, 1988). Killer whales in the Hatteras-Fundy region probably respond to the migration and seasonal distribution patterns of prey species, such as bluefin tuna, herring, and squids (Katona et al., 1988; Gormley, 1990).

- **General Distribution—**Killer whales are found throughout all oceans and contiguous seas, from equatorial regions to polar pack ice zones of both hemispheres. In the western North Atlantic, killer whales are known from the polar pack ice, off of Baffin Island, and in Labrador Sound southward to Florida, the Bahamas, and the Gulf of Mexico (Dahlheim and Heyning, 1999), where they have been sighted year-round (Jefferson and Schiro, 1997; O'Sullivan and Mullin, 1997). A year-round killer whale population in the western North Atlantic may exist south of around 35°N (Katona et al., 1988).

  In the Atlantic, calving takes place in late fall to mid-winter (Jefferson et al., 2008). However, the location of killer whale breeding in the North Atlantic is unknown.

<u>Occurrence in the Site A USWTR</u>—Killer whale sightings in the Jacksonville OPAREA and its vicinity have been recorded close to shore (DoN, 2008n). However, just to the north of the OPAREA, there are sightings in deep waters seaward of the continental shelf break. Occurrence in the Site A USWTR is expected seaward of the shoreline year-round based on available sighting data and the diverse habitat preferences of this species.

Long-finned and Short-finned Pilot Whales – Site A

- **General Description—**Pilot whales are among the largest dolphins, with long-finned pilot whales potentially reaching 5.7 m (19 ft) (females) and 6.7 m (22 ft) (males) in length. Short-finned pilot whales may reach 5.5 m (18 ft) (females) and 6.1 m (20 ft) (males) in length (Jefferson et al., 1993). The flippers of long-finned pilot whales are extremely long, sickle shaped, and slender, with pointed tips, and an angled leading edge that forms an "elbow". Long-finned pilot whale flippers range from 18 to 27 percent of length. Short-finned pilot whales have flippers that are somewhat shorter than long-finned pilot whale at 16 to 22 percent of the total body length (Jefferson et al., 1993). Both pilot whale species feed primarily on squid but also take fish (Bernard and Reilly, 1999).

- **Status—**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). Pilot whales are under the jurisdiction of NMFS.

- **Diving Behavior—**Pilot whales are deep divers, staying submerged for up to 27 min and routinely diving to 600 to 800 m (1,967 to 2,625 ft) (Baird et al., 2003; Aguilar de Soto et al., 2005). Mate (1989) described movements of a satellite-tagged, rehabilitated long-finned pilot whale released off Cape Cod that traveled roughly 7,600 km (4,101 NM) during the three months of the tag's operation. Daily movements of up to 234 km (126 NM) are documented. Deep diving occurred mainly at night, when prey within the deep scattering layer approached the surface. Tagged long-finned pilot whales in the Ligurian Sea were also found to make their deepest dives (up to 648 m [2,126 ft]) after dark (Baird et al., 2002). Two rehabilitated juvenile long-finned pilot whales released south of Montauk Point, New York made dives in excess of 26 min (Nawojchik et al., 2003). However, mean dive duration for a satellite tagged long-finned pilot whale in the Gulf of Maine ranged from 33 to 40 s, depending upon the month (July through September) (Mate et al., 2005).

- **Acoustics and Hearing—**Pilot whale sound production includes whistles and echolocation clicks. Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz (Ketten, 1998; Richardson et al., 1995), respectively, at an estimated source level of 180 dB re 1 μPa-m peak (DoN, 1976; Ketten, 1998). Rendell and Gordan (1999) recorded vocalizations from a group of approximately 50 long-finned pilot whales in the Ligurian Sea in conjunction with the presence of military sonar signals, which facilitated an examination of this species short-term response to external sound sources. Whistle production was examined in relation to sonar pulses: frequency ranged from 4.1 to 8.7 kHz with a mean duration of .93 s, and showed varying contour patterns spectrographically (Rendell and Gordon, 1999). Preliminary results from these data suggest that certain whistles were associated with sonar signals;

however, the functional meaning of how these signals might be correlated to external sonar is unclear. Long-finned pilot whales have been shown to modify their whistle characteristics in the presence of sonar transmissions in the Ligurian sea (Rendell and Gorden, 1999).

There are no hearing data available for either pilot whale species. However, the most sensitive hearing range for odontocetes generally includes high frequencies (Ketten, 1997).

- **Habitat—**Pilot whales occur along the continental shelf break, in continental slope waters, and in areas of high-topographic relief (Olson and Reilly, 2002). They also occur close to shore at oceanic islands where the shelf is narrow and deeper waters are nearby (Mignucci-Giannoni, 1998; Gannier, 2000; Anderson, 2005). While pilot whales are typically distributed along the continental shelf break, they are also commonly sighted on the continental shelf and inshore of the 100 m (328 ft) isobath, as well as seaward of the 2,000 m (6,560 ft) isobath north of Cape Hatteras (CETAP, 1982; Payne and Heinemann, 1993). Long-finned pilot whale sightings extend south to near Cape Hatteras (Abend and Smith, 1999) along the continental slope. Waring et al. (1992) sighted pilot whales principally along the northern wall of the Gulf Stream and along the shelf break at thermal fronts. A few of these sightings were also made in the mid-portion of the Gulf Stream near Cape Hatteras (Abend and Smith, 1999).

- **General Distribution—**Long-finned pilot whales are distributed in subpolar to temperate North Atlantic waters offshore and in some coastal waters. The short-finned pilot whale usually does not range north of 50°N or south of 40°S (Jefferson et al., 1993); however, short-finned pilot whales have stranded as far north as Rhode Island. Strandings of long-finned pilot whales have been recorded as far south as South Carolina (Waring et al., 2008). Short-finned pilot whales are common south of Cape Hatteras (Caldwell and Golley, 1965; Irvine et al., 1979). Long-finned pilot whales appear to concentrate during winter along the continental shelf break primarily between Cape Hatteras and Georges Bank (Waring et al., 1990). The apparent ranges of the two pilot whale species overlap in shelf/shelf-edge and slope waters of the northeastern U.S. between 35°N and 38° to 39°N (New Jersey to Cape Hatteras, North Carolina) (Payne and Heinemann, 1993); however, incidents of strandings of short-finned pilot whales as far north as Block Island, RI and Nova Scotia indicate that area of overlap may be larger than previously thought (Waring et al., 2008).

  Pilot whales concentrate along the continental shelf break from during late winter and early spring north of Cape Hatteras (CETAP, 1982; Payne and Heinemann, 1993). This corresponds to a general movement northward and onto the continental shelf from continental slope waters (Payne and Heinemann, 1993). Short-finned pilot whales seem to move from offshore to continental shelf break waters and then northward to approximately 39°N, east of Delaware Bay during summer (Payne and Heinemann, 1993). Sightings coalesce into a patchy continuum and, by December, most short-finned pilot whales occur in the mid-Atlantic slope waters east of Cape Hatteras (Payne and Heinemann, 1993). Although pilot whales appear to be seasonally migratory, sightings indicate common year-round residents in some continental shelf areas, such as the southern margin of Georges Bank (CETAP, 1982; Abend and Smith, 1999).

The calving peak for long-finned pilot whales is from July to September in the northern hemisphere (Bernard and Reilly, 1999). Short-finned pilot whale calving peaks in the northern hemisphere are in the fall and winter for the majority of populations (Jefferson et al., 2008). Locations of breeding areas are unknown.

Occurrence in the Site A USWTR—The Jacksonville OPAREA is located well south of the suggested overlap area for the two pilot whale species (Payne and Heinemann, 1993). Thus, the sightings of unidentified pilot whales in the Jacksonville OPAREA are most likely of the short-finned pilot whale (DoN, 2008n). The majority of pilot whale strandings on beaches adjacent to the Jacksonville OPAREA are of the short-finned pilot whale (Moore, 1953; Layne, 1965; Irvine et al., 1979; Winn et al., 1979; Schmidly, 1981). Schmidly (1981) reported on two possible long-finned pilot whale skulls from localities south of latitude 34°N (St. Catherine's Island, Georgia, was the southernmost record), but noted that their identification had not been verified. If those two records were proven to be of long-finned pilot whales, they would be the southernmost records for this species in the western North Atlantic. As deepwater species, pilot whales are expected seaward of the shelf break throughout the OPAREA year-round. They may also occur between the shore and shelf break which is supported by opportunistic sightings and bycatch records inshore of the shelf break to the north of the OPAREA (DoN, 2008n). Short-finned pilot whales are expected to occur throughout the Site A USWTR.

Harbor Porpoise – Site A

- **General Description—**Harbor porpoises are the smallest cetaceans in the North Atlantic with a maximum length of 2 m (7 ft) (Jefferson et al., 1993). The body is stocky, dark gray to black dorsally and white ventrally. There may be a dark stripe from the mouth to the flipper. The head is blunt, with no distinct beak. The flippers are small and pointed and the dorsal fin is short and triangular, located slightly behind the middle of the back.

- **Status –** There are four proposed harbor porpoise populations in the western North Atlantic: Gulf of Maine and Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland stocks (Gaskin, 1992). The best estimate of abundance for the Gulf of Maine and Bay of Fundy stock is 89,700 individuals (Waring et al., 2007).

- **Diving Behavior –** Harbor porpoises make brief dives, generally lasting less than 5 min (Westgate et al., 1995). Tagged harbor porpoise individuals spend 3 to 7 percent of their time at the surface and 33 to 60 percent in the upper 2 m (7 ft) (Westgate et al., 1995; Read and Westgate, 1997). Average dive depths range from 14 to 41 m (46 to 135 ft) with a maximum known dive of 226 m (741 ft) and average dive durations ranging from 44 to 103 seconds (Westgate et al., 1995). Westgate and Read (1998) noted that dive records of tagged porpoises did not reflect the vertical migration of their prey; porpoises made deep dives during both day and night.

- **Acoustics and Hearing –** Harbor porpoise vocalizations include clicks and pulses (Ketten, 1998), as well as whistle-like signals (Verboom and Kastelein, 1995). The dominant frequency range is 110 to 150 kHz, with source levels between 135 and 205 dB re 1 μPa (Ketten, 1998) (Villadsgaard, 2007). Echolocation signals include one or two low-frequency components in the 1.4 to 2.5 kHz range (Verboom and Kastelein, 1995).

  The auditory-evoked potential method suggests that the harbor porpoise actually has two frequency ranges of best sensitivity. More recent psycho-acoustic studies found the range of best hearing to be 16 to 140 kHz, with a reduced sensitivity around 64 kHz (Kastelein et al., 2002). Maximum sensitivity occurs between 100 and 140 kHz (Kastelein et al., 2002).

- **Habitat –** Most harbor porpoises are found on the continental shelf, with some sightings in continental slope and offshore waters (Westgate et al., 1998; Waring et al., 2007). However, pelagic drift net bycatches and movements of a satellite-tracked individual, which swam offshore into water over 1,800 m (5,900 ft) deep, indicate a potential offshore distribution (Read et al., 1996; Westgate et al., 1998).

- **General Distribution –** Harbor porpoises occur in subpolar to cool-temperate waters in the North Atlantic and Pacific (Read, 1999). Off the northeastern United States, harbor porpoise distribution is strongly concentrated in the Gulf of Maine/Georges Bank region, with more scattered occurrences to the mid-Atlantic (CETAP, 1982; Northridge, 1996). From July through September, harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy, generally in waters less than 150 m (492 ft) deep (Palka, 1995), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka, 2000). From October through December, harbor porpoise densities are widely dispersed from New Jersey to Maine, with lower densities to the north and south of this region (NMFS, 2001). From January through March, intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada (NMFS, 2001). Stranding data indicate that the southern limit is northern Florida (Polacheck, 1995; Read, 1999).

Occurrence in the Site A USWTR—The harbor porpoise primarily occurs on the continental shelf in cool temperate to subpolar waters (Read, 1999) that are at higher latitudes than the Jacksonville OPAREA. Northern Florida appears to be the southern limit for this species. Harbor porpoises may occur rarely in the portion of Site A USWTR over the continental shelf.

Pinnipeds (Seals) – Site A

Blaylock et al. (1995) reported that four seal species are known to occur in the western North Atlantic ocean: harbor seal, gray seal, harp seal, and hooded seal. Although there are many species of seals found in the western North Atlantic, none normally range as far south as the Jacksonville OPAREA. However, both harbor seals and hooded seals have been infrequently sighted in the OPAREA (DoN, 2008n). The probability of encountering a seal at the Site A USWTR is very low and all seal species are considered extralimital in the Jacksonville OPAREA.

Sirenians (Manatees) – Site A

- **General Description—**The West Indian manatee is a rotund, slow-moving animal, which reaches a maximum length of 3.9 m (13 ft) (Jefferson et al., 1993). Two important aspects of the West Indian manatee's physiology influence behavior: nutrition and metabolism. West Indian manatees have an unusually low metabolic rate and a high thermal conductance that lead to energetic stress in winter (Bossart et al., 2002). West Indian manatees are herbivores that feed opportunistically on a wide variety of submerged, floating, and emergent vegetation, but they also ingest invertebrates (USFWS, 2001; Courbis and Worthy, 2003; Reich and Worthy, 2006).

- **Status and Management—**West Indian manatee numbers are assessed by aerial surveys during the winter months when manatees are concentrated in warm-water refuges. Aerial surveys conducted in 2007 produced a preliminary abundance estimate 2,812 manatees in Florida (FMRI, 2007). Along Florida's Gulf Coast, observers counted 1,400 West Indian manatees, while observers on the Atlantic coast counted 1,412 (FMRI, 2007).

  The manatee is under the jurisdiction of the USFWS. In the most recent revision of the West Indian manatee recovery plan, it was concluded that, based upon movement patterns, West Indian manatees around Florida should be divided into four relatively discrete management units or subpopulations, each representing a significant portion of the species' range (USFWS, 2001b). Manatees found along the Atlantic U.S. coast make up two subpopulations: the Atlantic Region and the Upper St. Johns River Region (USFWS, 2001). Manatees from the western coast of Florida make up the other two subpopulations: the Northwest Region and the Southwest Region (USFWS, 2001b).

In 1976, critical habitat was designated for the West Indian manatee in Florida (USFWS, 1976). There are two types of manatee protection areas in the state of Florida: manatee sanctuaries and manatee refuges (USFWS, 2001b, 2002a,b). Manatee sanctuaries are areas where all waterborne activities are prohibited while manatee refuges are areas where activities are permitted but certain waterborne activities may be regulated (USFWS, 2001b, 2002a,b).

- **Diving Behavior—**Manatees are shallow divers. The distribution of preferred seagrasses is mostly limited to areas of high light; therefore, manatees are fairly restricted to shallower nearshore waters (Wells et al., 1999). It is unlikely that manatees descend much deeper than 20 m (66 ft), and don't usually remain submerged for longer than 2 to 3 min; however, when bottom resting, manatees have been known to stay submerged for up to 24 min (Wells et al., 1999).

- **Acoustics and Hearing—**West Indian manatees produce a variety of squeak-like sounds that have a typical frequency range of 0.6 to 12 kHz (dominant frequency range from 2 to 5 kHz), and last 0.25 to 0.5 s (Steel and Morris, 1982; Thomson and Richardson, 1995; Niezrecki et al., 2003). Recently, vocalizations below 0.1 kHz have also been recorded (Frisch and Frisch, 2003; Frisch, 2006). Overall, West Indian manatee vocalizations are considered relatively stereotypic, with little variation between isolated populations examined (i.e., between Florida and Belize populations; Nowacek et al., 2003). However, vocalizations have been newly shown to possess nonlinear dynamic characteristics (e.g., subharmonics or abrupt, unpredictable transitions between frequencies), which could aid in individual recognition and mother-calf communication (Mann et al., 2006). Average source levels for vocalizations have been calculated to range from 90 to 138 decibels referenced to 1 micropascal (dB re 1 μPa) (average: 100 to 112 dB re 1 μPa) (Nowacek et al., 2003; Phillips et al., 2004). 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).

- **Habitat—**Sightings of manatees are restricted to warm freshwater, estuarine, and extremely nearshore coastal waters. Manatees occur in very shallow waters of 2 to 4 m (7 to 13 ft) in depth generally close to shore (approximately less than 1 km [0.5 NM) (Beck et al., 2004). Shallow seagrass beds close to deep channels are preferred feeding areas in coastal and riverine habitats (Lefebvre et al., 2000; USFWS, 2001b). West Indian manatees are frequently located in secluded canals, creeks, embayments, and lagoons near the mouths of coastal rivers and sloughs. These areas serve as locations of feeding, resting, mating, and calving (USFWS, 2001b). Estuarine and brackish waters with access to natural and artificial freshwater sources are typical West Indian manatee habitat (USFWS, 2001). When ambient water temperatures drop below about 20°C (69°F) in fall and winter, migration to natural or anthropogenic warm-water sources takes place (Irvine, 1983). Effluents from sewage treatment plants are important sources of freshwater for West Indian manatees in the Caribbean Sea (Rathbun et al., 1985). Manatees are also observed drinking fresh water that flows out of the mouths of rivers (Lefebvre et al., 2001) and out of offered hoses at harbors (Fertl et al., 2005).

- **General Distribution—**The West Indian manatee occurs in warm, subtropical, and tropical waters of the western North Atlantic Ocean, from the southeastern U.S. to Central America, northern South America, and the West Indies (Lefebvre et al., 2001). West Indian manatees occur along both the Atlantic and Gulf coasts of Florida. West Indian manatees are sometimes reported in the Florida Keys; these sightings are typically in the upper Florida Keys, with some reports as far south as Key West (Moore, 1951b, 1951a; Beck, 2006). During winter months, the West Indian manatee population confines itself to inshore and inner shelf waters of the southern half of peninsular Florida and to springs and warm water outfalls (e.g., power plant cooling water outfalls) just beyond northeastern Florida. As water temperatures rise in spring, West Indian manatees disperse from winter aggregation areas.

  Several patterns of seasonal movement are known along the Atlantic coast ranging from year-round residence to long-distance migration (Deutsch et al., 2003). Individuals may be highly consistent in seasonal movement patterns and show strong fidelity to warm and winter ranges, both within and across years (Deutsch et al., 2003).

<u>Occurrence in the Site A USWTR</u>—Manatees are expected in the freshwater, estuarine, and nearshore coastal waters in or near the cable range portion of Site A throughout the year. They are not expected in the offshore portions of the Jacksonville OPAREA.

Designated Critical Habitat for the West Indian Manatee

Critical habitat for the West Indian manatee was designated under 41 Federal Register (FR) 41914 in 1976 with an augmentation and correction in 1977 (USFWS, 1976). The habitat extends throughout the state of Florida and encompasses the St Johns River and Lake George in and near the vicinity of the Jacksonville OPAREA. The designated area includes all of the West Indian manatee's known range at the time of designation (including waterways throughout about one-third to one-half of Florida) (Laist, 2002). This critical habitat designation has been infrequently used or referenced since it is broad in description, treats all waterways the same, and does not highlight any particular areas (Laist, 2002).

3.2.6.2 Site B

The Site B USWTR is located within the Charleston OPAREA (Figure 2-17). Following is a general description of the marine mammals that may occur in the Charleston OPAREA, if not already described in the previous section, and more specifically, in the vicinity of the Site B USWTR.

Mysticetes

Records for baleen whales in the Charleston OPAREA include the North Atlantic right whale, humpback whale, minke whale, Bryde’s whale, sei whale, fin whale, and blue whale.

North Atlantic Right Whale – Site B

The coastal waters of the Carolinas are suggested to be a migratory corridor for the Northern Atlantic right whale between their calving grounds off Georgia and Florida and their feeding grounds in the Gulf of Maine (Winn et al., 1986). Right whales may travel through the USWTR Site B during their migrations to and from calving grounds (DoN, 2008n). An examination of sighting records from all sources between 1950 and 1992 found that wintering Northern Atlantic right whales were observed widely along the coast from Cape Hatteras to Miami (Kraus et al., 1993). Sightings off the Carolinas were comprised of single individuals that appeared to be transients (Kraus et al., 1993). These observations are consistent with the hypothesis that the coastal waters of the Carolinas are part of a migratory corridor for the Northern Atlantic right whale (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 Atlantic right whale sightings occurred within approximately 56 km (30 NM) from shore. Until better information is available on the width of the Northern Atlantic right whale’s migratory corridor, it has been recommended that management considerations are needed for the coastal areas along the mid-Atlantic migratory corridor within 65 km from shore (35 NM) (Knowlton, 1997). North Atlantic right whales are expected in the Site B USWTR.

Humpback Whale –Site B

Humpback whales may occur throughout the Charleston OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. There is an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al., 1993; Swingle et al., 1993; Wiley et al., 1995; Laerm et al., 1997). Humpback whales are not expected in the Charleston OPAREA during summer since they should occur further north on their feeding grounds. Humpback whales may occur in the Site B USWTR during fall, winter, and spring while migrating to and from the Caribbean winter calving grounds, but are not expected to occur in the Site B USWTR during summer.

Minke Whale – Site B

Minke whales are more abundant in New England waters than the mid-Atlantic (Hamazaki, 2002; Waring et al., 2006). The southernmost sighting in recent NMFS shipboard surveys was of one individual offshore of the mouth of Chesapeake Bay, in waters with a bottom depth of 3,475 m (11,400 ft) (Mullin and Fulling, 2003). There appears to be a strong seasonal component to minke whale distribution (Horwood, 1990). 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 Charleston OPAREA, primarily in shelf and deep waters (DoN, 2008n). Minke whales are expected in the Site B USWTR.

Bryde's Whale – Site B

There is a general lack of knowledge of this species, particularly in the North Atlantic, although records support a tropical occurrence for the species (Mead, 1977). Although no confirmed sightings of Bryde's whales have been recorded in the Charleston OPAREA, strandings have been recorded in this region throughout the year (DoN, 2008n). Bryde's whales may occur throughout the OPAREA year-round (DoN, 2008n). Bryde's whales may occur in the Site B USWTR.

Sei Whale – Site B

In the western North Atlantic Ocean, sei whales occur primarily from Georges Bank north to Davis Strait (northeast Canada, between Greenland and Baffin Island) (Perry et al., 1999). One sei whale stranding is recorded near Cape Island, South Carolina (Mead, 1977). Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Based on their preference for deep, oceanic waters, sei whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Charleston OPAREA during fall, winter, and spring. Sei whale occurrence is probably the same during these seasons due to early or late migrating individuals. Sei whales are not expected to occur in the OPAREA during summer since they should be on feeding grounds around the eastern Scotian Shelf or Grand Banks. Sei whales may occur in the deep water portions of Site B USWTR during fall, winter, and spring.

Fin Whale – Site B

Fin whales are more commonly encountered north of Cape Hatteras (CETAP, 1982; Hain et al,. 1992; Waring et al., 2007). Fin whales may occur in both continental shelf and offshore waters. Preliminary results from the Navy's deep water hydrophone arrays indicate a substantial deep-ocean component to fin whale distribution (Clark, 1995; Waring et al., 2007). There are only a few sighting records of this species here, likely due to incomplete survey coverage throughout the deep waters of the Charleston OPAREA as well as the fact that fin whales may be difficult to distinguish from some other rorqual species during survey efforts. Fin whales have only been sighted in the Charleston OPAREA in winter (DoN, 2008n); however, fin whales may occur in the 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 Charleston OPAREA. Fin whales may occur in the Site B USWTR during fall, winter, and spring.

Blue Whale – Site B

Blue whales have never been sighted or reported to strand in the OPAREA. The absence of records of blue whales in the Charleston OPAREA does not necessarily indicate the absence of this species, but may reflect the fact blue whales are often difficult to distinguish from other large rorquals (DoN, 2008n). This whale is primarily a deep-water species. Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Blue whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Charleston OPAREA during fall, winter, and spring. Blue whales are not expected to occur in the Charleston OPAREA during summer when they should occur farther north in their feeding ranges. Blue whales may occur in deep water portions of Site B USWTR during fall, winter, and spring.

Odontocetes

Following is a general discussion of the distribution of odontocete species that may be found in the Charleston OPAREA in the vicinity of Site B.

Sperm Whale – Site B

There are a number of historical stranding and whaling records of sperm whales within and adjacent to the Charleston OPAREA (Moore, 1953; Caldwell et al., 1971; Winn et al., 1979). In fact, sperm whales in the 1800s were frequently taken by whaling boats on the Charleston Grounds off Charleston, South Carolina during January (Townsend, 1935). Whaling records suggest an offshore distribution of sperm whales off the southeastern U.S., over the Blake Plateau, and into deep waters (Schmidly, 1981). Occurrence of sperm whales in the Charleston OPAREA may be underestimated due to the sparse survey effort in offshore waters of this region, particularly during the winter when Northern Atlantic right whale survey effort is concentrated in nearshore waters where sperm whales are not generally found (DoN, 2008n). Sperm whales may occur in the Charleston OPAREA from the vicinity of the continental shelf break continuing beyond the eastern boundary of the OPAREA throughout the year (DoN, 2008n). Sperm whales are expected seaward of the shelf break in the Site B USWTR.

Pygmy and Dwarf Sperm Whales – Site B

In the North Atlantic, pygmy and dwarf sperm whales (*Kogia breviceps* and *K. sima*, respectively) are shelf-edge species occurring in warm-temperate to tropical waters (DoN, 2002d). *Kogia* generally occur along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). There are very few sighting records of *Kogia* in the Charleston OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall), as well as their avoidance reactions towards ships (DoN, 2008n). Occurrence of *Kogia* in the vicinity of the Site B USWTR is recognized based on the large number of strandings recorded throughout the year (DoN, 2008n). *Kogia* may occur seaward of the shelf break throughout the Charleston OPAREA and the Site B USWTR year-round.

Beaked Whales – Site B

Beaked whales are deep water species. Based on the cryptic behavior and similarity in appearance of these species, it is often difficult to identify beaked whales to the species level. 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). Of note is a mass stranding of four Blainville's beaked whales in North Carolina (unspecified exact location) that occurred subsequent to Hurricane Bonnie in 1998 (Norman and Mead, 2001). There are few sighting records of beaked whales in the OPAREA, which is likely due to incomplete survey coverage throughout most of the deep waters of the OPAREA. 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.

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.

Bottlenose Dolphin – Site B

Bottlenose dolphins are abundant in continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring et al., 2007). The greatest concentrations of offshore animals are along the continental shelf break and between the 200 and 2,000 m isobaths (656 to 6,562 ft) (Kenney, 1990; Waring et al., 2007). However, the range of offshore bottlenose dolphins may actually extend into deeper waters (Wells et al., 1999). The bottlenose dolphin may occur in Site B USWTR as well as throughout the Charleston OPAREA year-round.

Atlantic Spotted Dolphin – Site B

Spotted dolphins may occur from the coastline to seaward of the eastern boundary of the Charleston OPAREA throughout the year. Atlantic spotted dolphins may occur in both continental shelf and offshore waters (Perrin et al., 1994a). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of pantropical spotted dolphins in offshore waters of the OPAREA may be more of a reflection of survey observers not distinguishing between the two species (DoN, 2008n). Atlantic spotted dolphins may occur in continental shelf and offshore waters throughout the Charleston OPAREA (DoN, 2008n). The Atlantic spotted dolphin is expected throughout Site B USWTR.

Pantropical Spotted Dolphin – Site B

The pantropical spotted dolphin is a deep water species (Jefferson et al., 1993). Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring et al., 2007). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of pantropical spotted dolphins in offshore waters of the Charleston OPAREA may be more of a reflection of survey observers not distinguishing between the two species (DoN, 2008n). Pantropical spotted dolphins may occur seaward of the shelf break throughout the Charleston OPAREA (DoN, 2008n). Pantropical spotted dolphins are expected in the areas seaward of the shelf break within the Site B USWTR.

Spinner Dolphin – Site B

Spinner dolphin sighting, stranding, and bycatch records are documented in or near the OPAREA throughout much of the year (DoN, 2008n). Spinner dolphins may occur from the shelf break to eastward of the OPAREA boundary based on the spinner dolphin's preference for deep, warm waters (DoN, 2008n). No seasonal differences in occurrence are anticipated. Spinner dolphins are expected seaward of the shelf break in Site B USWTR.

Clymene Dolphin – Site B

Clymene dolphins have been found stranded along the Atlantic coast of Florida adjacent to the Charleston OPAREA and further south throughout the year (Caldwell and Caldwell, 1975; Perrin et al., 1981; Fertl et al., 2003). The summer sighting in continental shelf waters was recorded during aerial surveys and may be a misidentification since Clymene dolphins are not typically sighted in such shallow waters. Based on confirmed sightings and the preference of this species for deep waters, Clymene dolphins may occur in waters seaward of the shelf break throughout the Charleston OPAREA (DoN, 2008n). The Clymene dolphin is expected seaward of the shelf break in the Site B USWTR.

Striped Dolphin – Site B

The striped dolphin is a deep water species that is generally distributed north of Cape Hatteras (CETAP, 1982). In the JAX/CHASN OPAREA, there are only two sightings of the striped dolphin (DoN, 2008n). 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). 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.

Common Dolphin – Site B

Common dolphins occur along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). This species is less common south of Cape Hatteras (Waring et al., 2007); occurrence south of Cape Hatteras is considered questionable (Kenney, 2007). 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 Charleston 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.

Fraser's Dolphin – Site B

Fraser's dolphin is a deep-water species that prefers warm waters. While there are no confirmed records of Fraser's dolphin in the Charleston OPAREA, there is one confirmed sighting farther north in deep waters (>3,000 m [9,843 ft] in depth) offshore of Cape Hatteras (NMFS-SEFSC, 1999). Fraser's dolphins may occur seaward of the shelf break throughout the Charleston OPAREA year-round. Fraser's dolphin may occur seaward of the shelf break in Site B USWTR.

Risso's Dolphin – Site B

Globally, Risso's dolphin is most commonly found in areas with steep bottom topography, such as the area seaward of the continental shelf break, and is often sighted in association with Gulf Stream warm-core rings which are areas of enhanced productivity. Risso's dolphin may occur year-round along the path of the Gulf Stream and including steep portions of the continental slope in the in the Charleston OPAREA and 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 Site B USWTR.

Melon-headed Whale – Site B

Melon-headed and pygmy killer whales can be difficult to distinguish from one another, and on many occasions, only a determination of "pygmy killer whale/melon-headed whale" can be made. The melon-headed whale is an oceanic species; which may occur seaward of the shelf break year-round (DoN, 2008n). Melon-headed whales may occur in the deep water portions of Site B USWTR.

Pygmy Killer Whale – Site B

Records of pygmy killer whales in this region include several strandings inshore of the JAX/CHASN OPAREA and two sightings in offshore waters of the OPAREA (DoN, 2008n). The pygmy killer whale is an oceanic species; which may occur seaward of the shelf break year-round. Pygmy killer whales may occur seaward of the shelf break in Site B USWTR.

False Killer Whale – Site B

False killer whales occur in offshore, warm waters worldwide (Baird, 2002). A small number of sightings are recorded in offshore waters of the OPAREA (DoN, 2008n). Strandings are also recorded in this region. False killer whales may occur in the Charleston OPAREA and are expected seaward of the shelf break throughout the year. False killer whales may occur in the deep water portions of Site B USWTR.

Killer Whale – Site B

A small number of killer whale sightings are recorded in both shallow and deep waters of the JAX/CHASN OPAREA and vicinity (DoN, 2008n). Killer whales may occur throughout the OPAREA year-round based on sighting data and the diverse habitat preferences of this species. Killer whales are expected throughout Site B USWTR.

Long-finned and Short-finned Pilot Whales – Site B

Identification of pilot whales to species is difficult at sea, and identification is often made to the generic level only. The Charleston OPAREA is located south of the suggested region of overlap between both pilot whale species (Payne and Heinemann, 1993). Thus, sightings of unidentified pilot whales in the OPAREA are most likely of short-finned pilot whales which are more common south of Cape Hatteras. The majority of pilot whale strandings on beaches inshore of the OPAREA are of the short-finned pilot whale (Moore, 1953; Layne, 1965; Irvine et al., 1979; Winn et al., 1979; Schmidly, 1981). Short-finned pilot whales may occur throughout the Charleston OPAREA during most of the year (DoN, 2008n). Short-finned pilot whales are expected in the Site B USWTR.

Harbor Porpoise – Site B

The harbor porpoise primarily occurs on the continental shelf, in cool temperate to subpolar waters (Read, 1999), that are at higher latitudes than the Charleston OPAREA. Occurrences of harbor porpoises in the mid-Atlantic are scattered (CETAP, 1982; Northridge, 1996). Stranding data indicate that the southern limit is northern Florida (Polacheck, 1995; Read, 1999) and are unlikely to occur in the Charleston OPAREA in spring, summer, or fall (DoN, 2008n). Harbor porpoises may occur rarely in the Site B USWTR.

Pinnipeds (Seals) – Site B

Vagrant harbor seals are occasionally found as far south as the Carolinas and as far south as Daytona Beach, Florida (Caldwell and Caldwell, 1969). Winn et al. (1979) suggested that harbor seals found in this area are likely young individuals that disperse from the north during the winter months. Sightings and strandings of harbor seals have been documented throughout the year in South Carolina (Caldwell, 1961; Caldwell and Golley, 1965; McFee, 2006).

Several records of hooded seals have been reported in North Carolina, Georgia, and Florida (Goodwin, 1954; Mignucci-Giannoni and Odell, 2001; Harry et al., 2005). It is possible for vagrant hooded seals to be found near the Charleston OPAREA throughout the year.

Despite records of seal species in and near the OPAREA, all pinniped species are considered extralimital in the Charleston OPAREA and the Site B USWTR.

Sirenians (Manatees) – Site B

West Indian manatees occur in warm, subtropical, and tropical waters of the western North Atlantic from the southeastern U.S. to Central America, northern South America, and the West Indies, primarily in freshwater systems, estuaries, and shallow, nearshore, coastal waters (Lefebvre et al., 2001). Manatees are frequently reported in the coastal rivers of Georgia and South Carolina during warmer months (Zoodsma, 1991; Lefebvre et al., 2001). Sightings on the Atlantic coast drop off markedly north of South Carolina (Lefebvre et al., 2001). Manatees may occur in Site B USWTR.

3.2.6.3 Site C

As stated previously, the Site C is located within the Cherry Point OPAREA (Figure 2-21). Following is a general description of the distribution of the marine mammals that may occur in the Cherry Point OPAREA and more specifically in the vicinity of the Site C USWTR.

Mysticetes

There are records for baleen whale species in North Carolina waters as follows: North Atlantic right whale, humpback whale, minke whale, Bryde's whale, sei whale, and fin whale. There are no records of blue whales in North Carolina waters, although their distribution and range may include North Carolina (NMFS, 1998b; Waring et al., 1997, 1999).

North Atlantic Right Whale – Site C

The coastal waters of the Carolinas are part of a migratory corridor for the right whale (Winn et al., 1986; Knowlton et al., 2002). There have been opportunistic sightings of right whales in deep waters of the Cherry Point OPAREA (DoN, 2008l). There is a lack of survey effort for right whales in offshore waters (and the Cherry Point OPAREA specifically).

Knowlton et al. (2002) reviewed right whale sightings and survey efforts for the mid-Atlantic and reported that 94 percent of the right whale sightings were within 55 km (30 NM) of the coast, that well over half the sightings (64 percent) were within 18.5 km (10 NM) of the coast, and that 80 percent of all tagged animal sightings occurred within 55 km (30 NM) of land.

North Atlantic right whale occurrence in the Cherry Point 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 Cherry Point OPAREA (DoN, 2008l). The North Atlantic right whale is expected to occur in the vicinity of the Site C USWTR.

Humpback Whale – Site C

Humpback whales may occur on the continental shelf and in deep waters of the Cherry Point OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. (DoN, 2008l). There is an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al., 1993; Swingle et al., 1993; Wiley et al., 1995; Laerm et al., 1997). Sightings of humpback whales migrating through this area are likely not well-represented here due to the lack of survey effort in offshore waters of the Cherry Point OPAREA. Humpback whales are not expected to occur in the Cherry Point OPAREA during summer when they should occur farther north on their feeding grounds (DoN, 2008l). Humpback whales may occur in the Site C USWTR during fall, winter, and spring

Minke Whale – Site C

Minke whales are only occasionally found, and on a widely-scattered basis, in the mid-Atlantic area (CETAP, 1982). There is a more common occurrence further north of the Cherry Point OPAREA (Hamazaki, 2002; Waring et al., 2006). The dynamics of the Gulf Stream in the Cape Hatteras region probably play a role in the zoogeography of minke whales throughout much of the year. There are no records of minke whales within the 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 Cherry Point 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.

Bryde's Whale – Site C

There is a general lack of knowledge of Bryde's whale, particularly in the North Atlantic, although records support a tropical occurrence for the species (Mead, 1977). An extralimital Bryde's whale stranding is recorded from the winter of 1927 well within Chesapeake Bay (Mead, 1977). Bryde's whale has been known to strand farther south on the coasts of Georgia and eastern Florida (Schmidly, 1981). Although a tropical species, Bryde's whales may occur within the Cherry Point OPAREA and the Site C USWTR.

Sei Whale – Site C

No sei whale records are documented for the Cherry Point OPAREA, but sightings are recorded further north (DoN, 2008l). The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Acoustic data support the hypothesis of an offshore wintering habitat (Clark, 1995). Based on their preference for deep, oceanic waters, sei whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Cherry Point OPAREA during fall, winter, and spring. Sei whale occurrence is probably the same during these seasons due to individual whales migrating earlier or later in the year (and appearing in a different season). Sei whales are not expected to occur in the Cherry Point 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 Site C USWTR during fall, winter, and spring.

Fin Whale – Site C

Fin whales are more commonly encountered north of Cape Hatteras (CETAP, 1982; Hain et al., 1992; Waring et al., 2007). The dynamics of the Gulf Stream in the Cape Hatteras region probably play a role in the zoogeography of fin whales throughout much of the year. Fin whales may occur in both continental shelf and offshore waters. Preliminary results from the Navy's deepwater hydrophone arrays indicate a substantial deep-ocean component to fin whale distribution (Clark, 1995; Waring et al., 2007). There is only one sighting record of this species in the Cherry Point OPAREA. This is likely due to incomplete survey coverage throughout the deep waters of the OPAREA, as well as the fact that fin whales may be difficult to distinguish from some other rorqual species during survey efforts. During winter, fin whales may occur in the Cherry Point OPAREA. During spring and fall, fin whales may occur just north of the OPAREA, and could overlap the northern portion of the Cherry Point OPAREA (DoN, 2008l).

In the summer months, fin whales are expected to be farther north on feeding grounds and not likely to occur in the Cherry Point OPAREA (DoN, 2008l). Fin whales may occur in the Site C USWTR during fall, winter, and spring.

Blue Whale – Site C

The lack of blue whale records in the OPAREA may result from the fact that blue whales are often difficult to distinguish from other rorquals. The blue whale is primarily a deepwater species. Winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Acoustic data support the hypothesis of an offshore wintering habitat (Clark, 1995). Blue whales may occur in waters seaward of the 2,000 m (6,562 ft) isobath throughout the Cherry Point OPAREA during fall, winter, and spring (DoN, 2008l). Blue whales are not expected to occur in the Cherry Point OPAREA during summer when they should occur farther north in their feeding ranges (DoN, 2008l). Blue whales may occur in the deep water portions of Site C USWTR during fall, winter, and spring.

Odontocetes

Following is a general discussion of the distribution of odontocete species that may occur in the Cherry Point OPAREA.

Sperm Whale – Site C

Worldwide, sperm whales exhibit a strong affinity for deep waters beyond the continental shelf break (Rice, 1989). The recorded observations of sperm whales in the Cherry Point OPAREA and vicinity support this trend, with sightings consistently recorded in waters beyond the shelf break (DoN, 2008l). In winter, sightings are clustered in slope and deep waters in the northern end of the Cherry Point OPAREA (DoN, 2008l). The paucity of sighting data for the rest of the OPAREA is most likely due to incomplete survey effort in offshore waters. Sperm whales were never sighted during baseline surveys at the Site C USWTR location (13 aerial surveys totaling over 7,000 km [4,350 mi] of trackline) conducted from 1998 to 1999 by the University of North Carolina – Wilmington (UNCW) (DoN, 1999a). During the summer 1998 Southeast Fisheries Science Center (SEFSC)/NMFS surveys (Mullin, 1999), most sightings were north of Cape Hatteras, with only two far offshore in slope waters east of Cape Hatteras. During the summer 1999 SEFSC/NMFS surveys (Roden, 2000), two sightings were reported along the shelf edge east of Cape Lookout. Sperm whales may occur in the Site C USWTR year-round.

Pygmy and Dwarf Sperm Whales – Site C

Pygmy and dwarf sperm whales (*Kogia)* generally occur along the continental shelf break and over the continental slope (e.g., Baumgartner et al., 2001; McAlpine, 2002). There are very few sighting records of *Kogia* in the Cherry Point OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during spring and fall) as well as their avoidance reactions towards ships (DoN, 2008l). However, several strandings are recorded inshore of the OPAREA boundaries during all seasons and support the likelihood of *Kogia* occurrence in waters off North Carolina (Hohn et al., 2006; MMC, 2006).

Kogia may occur over the shelf break and seaward throughout the year. Pygmy and dwarf sperm whales are expected to occur in Site C USWTR.

Beaked Whales – Site C

Based upon available data, six beaked whales are known to occur in the Cherry Point 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 Cherry Point OPAREA (DoN, 2008l).

With respect to the Cherry Point OPAREA, the continental slope is relatively wide south of Hatteras, and at-sea sightings of beaked whales are few, although sighting effort has been limited in this area. Sightings of all beaked whale species recorded in waters along the U.S. Atlantic coast indicate a pattern of distribution similar to that described by Pitman (2002). Nearly all sightings were made in very deep waters (>200m [660 ft]) near the continental shelf edge, within the Gulf Stream or Gulf Stream features such as warm core eddies and the north wall (CETAP, 1982; Waring et al., 1992; Tove, 1995; Waring et al., 2001a; Waring et al, 2002). There is one extralimital stranding record of a northern bottlenose whale (also in the beaked whale family) inshore of the Cherry Point OPAREA. Of note is a mass stranding of four Blainville’s beaked whales in North Carolina (unspecified exact location) that occurred subsequent to Hurricane Bonnie in 1998 (Norman and Mead, 2001). There are very few sighting records of beaked whales in the Cherry Point 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 have been observed in the area around Cape Hatteras by a charter boat fisherman (Patterson, 2008). The location where these observations have been made averages 200 km (107 NM) to the north of Site C; the oceanography and ecology of this area is different than Site C due to the influence of the Hatteras Front. This area has been identified as an area with relatively high diversity and abundance of marine species. 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.

Rough-toothed Dolphin – Site C

Rough-toothed dolphins may occur seaward of the shelf break. During the winter, the rough-toothed dolphin’s occurrence is expected in warmer waters, so the occurrence in the Cherry Point OPAREA follows the western edge of the standard deviation of the Gulf Stream (DoN, 2008l). A few strandings and one sighting of the rough-toothed dolphin have been recorded near the Cherry Point OPAREA (DoN, 2008l). The rough-toothed dolphin is expected to occur seaward of the shelf break in Site C USWTR.

Bottlenose Dolphin – Site C

Bottlenose dolphins are abundant in continental shelf and inner slope waters throughout the western North Atlantic (CETAP, 1982; Kenney, 1990; Waring et al., 2007). The greatest concentrations of offshore animals are along the continental shelf break and between the 200 and 2,000 m isobaths (656 to 6,562 ft) (Kenney, 1990; Waring et al., 2007). However, the range of offshore bottlenose dolphins may actually extend into deeper waters (Wells et al., 1999), possibly even over the Hatteras Abyssal Plain just southeast of the Cherry Point OPAREA. The nearshore waters of the Outer Banks serve as winter habitat for coastal bottlenose dolphins (Read et al., 2003). Cape Hatteras represents important habitat for bottlenose dolphins, particularly in winter, as evidenced from concentrations of bottlenose dolphins during recent aerial surveys (Torres et al., 2005).

In North Carolina, there is significant overlap between distributions of coastal and offshore dolphins during the summer. North of Cape Lookout, there is a separation of the two stocks by bottom depth; the coastal form occurs in nearshore waters (<20 m [<66 ft] deep) while the offshore form is in deeper waters (>40 m [>131 ft] deep) (Garrison and Hoggard, 2003); however, south of Cape Lookout to northern Florida, there is significant spatial overlap between the two stocks. In this region, coastal dolphins may be found in waters as deep as 31 m (102 ft) and 75 km (40 NM) from shore while offshore dolphins may occur in waters as shallow as 13 m (43 ft) (Garrison et al., 2003). Additional aerial surveys and genetic sampling are required to better understand the distribution of the two stocks throughout the year. The bottlenose dolphin is expected to occur in Site C USWTR.

Atlantic Spotted Dolphin – Site C

Atlantic spotted dolphins may occur in both continental shelf and offshore waters (Perrin et al., 1994a); resulting in broad range of distribution in the Cherry Point OPAREA (DoN, 2008l). Sightings are scattered throughout the OPAREA (DoN 2008l). In the Atlantic, this species is considered broadly sympatric with pantropical spotted dolphins (Perrin and Hohn, 1994) and the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of Atlantic spotted dolphins in offshore waters of the OPAREA may be more of a reflection of survey observers not distinguishing between the two species. Atlantic spotted dolphins may occur throughout the Cherry Point OPAREA year-round and are expected to occur in Site C USWTR.

Pantropical Spotted Dolphin – Site C

The pantropical spotted dolphin is a deepwater species (Jefferson et al., 1993). Pantropical spotted dolphins have been sighted along the Florida shelf and slope waters and offshore in Gulf Stream waters southeast of Cape Hatteras (Waring et al., 2007). In the Atlantic, this species is considered broadly sympatric with Atlantic spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of pantropical spotted dolphins in offshore waters of the Cherry Point OPAREA may be more of a reflection of survey observers not distinguishing between the two species. Pantropical spotted dolphins may occur in the deepwater portions of the Cherry Point OPAREA. They are expected to occur seaward of the shelf break in Site C USWTR.

Spinner Dolphin – Site C

There is only one sighting record for the spinner dolphin in the Cherry Point OPAREA; several sighting and bycatch records are north of this area (DoN, 2008l). Spinner dolphins prefer offshore, warm water habitats. Spinner dolphins may occur from the vicinity of the continental shelf break to eastward of the OPAREA boundary based on the known habitat preferences of this species. No seasonal differences in occurrence are anticipated. The spinner may occur near and seaward of the shelf break in Site C USWTR.

Clymene Dolphin – Site C

Clymene dolphin sightings have been recorded in offshore waters in or near the OPAREA (DoN, 2008l). The oceanographic features of the Gulf Stream likely influence the distribution of Clymene dolphins in this area. Based on confirmed sightings and the preference of this species for deep waters, Clymene dolphins may occur in waters seaward of the shelf break throughout the Cherry Point OPAREA (DoN, 2008l). The Clymene dolphin may occur seaward of the shelf break in Site C USWTR.

Striped Dolphin – Site C

The striped dolphin is a deepwater species that is generally distributed north of Cape Hatteras (CETAP, 1982). In the Cherry Point 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 Cherry Point 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.

Common Dolphin – Site C

Common dolphins occur along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). This species is less common south of Cape Hatteras (Waring et al., 2007); common dolphin occurrence south of Cape Hatteras is questionable (Kenney, 2007). In winter, the common dolphin may occur north of the 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 and includes waters over the continental shelf and slope as well as nearshore waters (DoN, 2008l). Common dolphins are expected to occur in the Site C USWTR.

Fraser's Dolphin – Site C

One confirmed sighting of Fraser's dolphin was recorded in deep waters (>3,000 m [9,843 ft] in depth) offshore of Cape Hatteras (NMFS-SEFSC, 1999). Based on known preferences for deep-water, Fraser's dolphins may occur seaward of the shelf break throughout the Cherry Point OPAREA year-round. The Fraser's dolphin may occur seaward of the shelf break in 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 Cherry Point 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 seaward in the Cherry Point OPAREA. Risso's dolphins are expected to occur in the vicinity of the shelf break and seaward of the shelf break in Site C USWTR.

Melon-headed Whale – Site C

Melon-headed and pygmy killer whales can be difficult to distinguish from one another, and on many occasions, only a determination of "pygmy killer whale/melon-headed whale" can be made. One sighting of around 80 melon-headed whales is recorded in offshore waters north of the Cherry Point OPAREA (DoN, 2008l). The melon-headed whale is an oceanic species; which may occur seaward of the shelf break year-round. The melon-headed whale is expected to occur in the seaward of the shelf break in Site C USWTR.

Pygmy Killer Whale – Site C

Few strandings and an offshore sighting of the pygmy killer whale are recorded near the Cherry Point OPAREA (DoN, 2008l). The pygmy killer whale is an oceanic species; which may occur seaward of the shelf break year-round. The pygmy killer whale is expected to seaward of the shelf break in Site C USWTR.

False Killer Whale – Site C

False killer whales occur in offshore, warm waters worldwide (Baird, 2002). The warm waters of the Gulf Stream likely influence their occurrence to the north of the Cherry Point OPAREA. A small number of sightings are recorded in the OPAREA (DoN, 2008l). False killer whales may occur seaward of the shelf break throughout the year. The false killer whale is expected to occur in the seaward of the shelf break in Site C USWTR.

Killer Whale – Site C

A small number of killer whale sightings are recorded in both shallow and deep waters of the OPAREA and vicinity. Strandings are also reported along the coast of North Carolina (DoN, 2008l). Killer whales may occur seaward of the shoreline year-round based on sighting data and the diverse habitat preferences of this species. They are expected to occur in Site C USWTR.

Long-finned and Short-finned Pilot Whales – Site C

Identification of pilot whales to the species level is difficult at sea, and the Cherry Point OPAREA is located in the overlap area for the ranges of both pilot whale species (Payne and Heinemann, 1993). Throughout the year, pilot whales are predicted to occur in waters with steep bottom topography, such as Hatteras Canyon, and steep slope areas (DoN, 2008l). Pilot whales are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Throughout most of the deep waters of the Cherry Point OPAREA there is a lack of sufficient survey effort to accurately predict the occurrence patterns of these species. Pilot whales may occur from around the shelf break to deep, offshore waters. Pilot whales are expected to occur in 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 Cherry Point 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 Cherry Point 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, 2008l). The harbor porpoise is expected to occur in Site C USWTR.

Pinnipeds (Seals) – Site C

Several strandings of harbor seals near the OPAREA have been recorded during the winter, spring, and fall (DoN, 2008l). Winn et al. (1979) suggested that harbor seals found in this area are likely young individuals that disperse from the north during the winter months. Stranding data support a consistent seasonal occurrence of harbor seals in this region (Harry et al., 2005). Between 2000 and 2005, at least 71 records of harbor seal strandings were reported for North Carolina and Virginia (Harry et al., 2005). Most of these strandings occurred between November and April and were of young individuals. In February 2003, a harbor seal was rescued from Cape Lookout, North Carolina (WhaleNet, 2003). Sightings and strandings of harbor seals have been documented throughout the year in South Carolina (McFee, 2006). Therefore, harbor seals may make their way south along the coast of North Carolina and occur near the OPAREA any time of the year. Harbor seals may occur near the Site C USWTR.

Any occurrences of the gray seal, harp seal, and hooded seal in the Cherry Point OPAREA are considered to be extralimital (DoN, 2008l). These species are not expected to occur in the vicinity of Site C USWTR.

Sirenians (Manatees) – Site C

One manatee stranding is recorded in the New River inshore of the OPAREA (DoN, 2008l). The vast majority of sightings in North Carolina waters are of subadults (Schwartz, 1995). It is possible that West Indian manatees may be expanding their range into North Carolina waters (Schwartz, 1995). West Indian manatees have been sighted in estuarine and coastal waters of North Carolina during all seasons, with summer and fall having the most reports (Schwartz, 1995). Based on their known habitat preferences, manatees may occur throughout the freshwater, estuarine, and nearshore coastal waters in or near the OPAREA and the Site C USWTR year-round.

3.2.6.4 Site D

The Site D USWTR is located within the VACAPES OPAREA (Figure 2-25). The majority of the species found in the VACAPES OPAREA belong to the order Cetacea (whales, dolphins, and porpoises). Following is a general description of the marine mammals that may occur in the VACAPES OPAREA if not already described in the previous sections, and more specifically, in the vicinity of the Site D USWTR.

While there is overlap between the marine mammal species occurring in the VACAPES and Cherry Point OPAREAs, the density of marine mammals is higher in the VACAPES area. The Gulf Stream, in concert with the canyons, banks, and cooler northern waters of Virginia, sets up conditions that are conducive to high productivity. Large standing stocks of marine mammals can be supported in areas where upwelling occurs and results in a very complex food chain in which marine mammals play a role as consumer of plankton, fish, and squid.

Mysticetes

Mysticetes utilize the VACAPES area regularly as feeding grounds, as well as during migration between northern and southern waters. Records for baleen whales in the VACAPES OPAREA include the North Atlantic right whale, humpback whale, minke whale, Bryde’s whale, sei whale, fin whale, and blue whale.

North Atlantic Right Whale – Site D

Although North Atlantic right whales are likely to be found on feeding grounds north of the VACAPES OPAREA during the summer, there have been sightings and strandings near the OPAREA (DoN 2008m). There have also been opportunistic sightings of right whales in deep waters of the VACAPES OPAREA (DoN, 2008m). There is a lack of survey effort for North Atlantic right whales in offshore waters (specifically in the VACAPES OPAREA). North

Atlantic right whales may occur in the VACAPES OPAREA during all seasons (DoN, 2008m). The North Atlantic right whale may occur in Site D USWTR.

Humpback Whale – Site D

Humpback whales occur on the continental shelf and in deep waters of the VACAPES OPAREA in fall, winter, and spring during migrations between calving grounds in the Caribbean and feeding grounds off the northeastern U.S. (DoN, 2008m). During the summer, humpback whales are found farther north at the feeding grounds; however one recorded sighting indicates that presence of individual animals is possible (DoN, 2008m). There is an increasing occurrence of humpback whale sightings and strandings during the winter (particularly January through April) along the U.S. Atlantic coast from Florida north to Virginia (Clapham et al. 1993; Swingle et al. 1993; Wiley et al. 1995; Laerm et al. 1997). Sightings of humpback whales migrating through this area are likely not well-represented here due to the lack of complete survey effort in offshore waters of the VACAPES OPAREA. The humpback whale is expected to occur in Site D USWTR.

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.

Bryde's Whale – Site D

There is one Bryde's whale stranding recorded from the winter of 1927 within Chesapeake Bay (Mead, 1977). A few unidentified Bryde's/sei whale records are also documented near the shelf break off the coast of Virginia (DoN, 1995b). Bryde's whales may occur throughout the VACAPES OPAREA and the Site D USWTR year-round.

Sei Whale – Site D

Sightings of sei whales in continental shelf and slope waters as well as farther offshore and strandings are documented in or near the OPAREA throughout the year (DoN, 2008m). The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982); acoustic data support this hypothesis of an offshore wintering habitat (Clark, 1995). 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 Site D USWTR.

Fin Whale – Site D

Fin whales are more commonly encountered north of Cape Hatteras than in more southern waters (CETAP, 1982; Hain et al., 1992; Waring et al., 2007). Fin whales may occur in both continental shelf and offshore waters of the VACAPES OPAREA year-round. Preliminary results from the Navy's deepwater hydrophone arrays indicate a substantial deep-ocean component to fin whale distribution (Clark, 1995; Waring et al., 2007). Sightings in the VACAPES OPAREA span shelf waters, the shelf break and deep water (DoN, 2008m). Fin whales may occur in both shelf and offshore waters of the OPAREA year-round (DoN, 2008m). The fin whale may occur in the vicinity of the Site D USWTR.

Blue Whale – Site D

In the VACAPES OPAREA there is only one blue whale record, a sighting made between the 3,000 and 4,000 m (9,842 and 13,123 ft) isobaths during a CETAP survey in 1969 (DoN, 2008m). The paucity of blue whale records in the VACAPES OPAREA may indicate that blue whales are often difficult to distinguish from other rorquals. The blue whale is primarily a deepwater species but is occasionally found in shallow, shelf waters. The winter range of most rorquals (blue, fin, sei, and minke whales) is hypothesized to be in offshore waters (Kellogg, 1928; Gaskin, 1982). Acoustic data support the hypothesis of an offshore wintering habitat (Clark, 1995). Blue whales may occur in waters seaward of the 50 m (164 ft) isobath throughout the VACAPES OPAREA during fall, winter, and spring (DoN, 2008m). Blue whales are not expected to occur in the OPAREA during summer when they should occur farther north in their feeding ranges. The blue whale may occur in the vicinity of the Site D USWTR during fall, winter, and spring.

Odontocetes

Following is a general discussion of the distribution of odontocete species that may be found in the Site D area.

Sperm Whale – Site D

Worldwide, sperm whales exhibit a strong affinity for deep waters beyond the continental shelf break (Rice, 1989). The recorded observations of sperm whales in the VACAPES OPAREA and vicinity support this trend, with sightings consistently recorded in waters beyond the shelf break (DoN, 2008m). While sperm whales are expected to be present year-round, there have been more sightings in spring and summer than in the other months (DoN, 2008m). Sperm whales may occur throughout the slope and deep waters of the OPAREA (DoN, 2008m). The sperm whale is expected to occur in the Site D USWTR.

Pygmy and Dwarf Sperm Whales – Site D

Few *Kogia* sightings are recorded in the VACAPES OPAREA which is likely due to incomplete survey coverage throughout most of the deep waters of this region (especially during winter and fall) as well as their avoidance reactions towards ships (DoN, 2008m). However, strandings are recorded inshore of the OPAREA boundaries during all seasons and support the likelihood of *Kogia* occurrence in the VACAPES OPAREA year-round. Pygmy and dwarf sperm whales are expected to occur in the Site D USWTR.

Beaked Whales – Site D

Beaked whales are deepwater species. Based on the cryptic behavior and similarity in appearance of these species, it is difficult to identify beaked whales to species. 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.

The proposed USWTR Site D location is situated in such a way that portions of the shelf, shelf edge, and slope are overlapped by the boundaries of the proposed training range (DoN, 1999b). During an examination of physical habitat characteristics of cetaceans in the Gulf of Mexico, beaked whales and other deep-diving species most often occurred in waters with the steepest sea surface temperature gradients. Such areas are likely associated with thermal fronts and eddy systems. Sightings of beaked whales have also been associated with canyon features between the 200- and 2,000-m (660- and 6,600-ft) isobaths that were not associated with noticeable thermal gradients. In the summer months, beaked whales use the shelf-edge region of the northeast coast as a primary habitat (Waring et al., 2001b).

Preliminary results of predictive habitat modeling performed by DoN (2004d) indicated that, in the vicinity of the Site D USWTR, areas classified as potential beaked whale habitat were primarily in waters deeper than approximately 500 m. This suggests that beaked whale habitat may largely be located to the east of the proposed range site, which encompasses depths of 55 to 366 m (188 to 1,200 ft).

Rough-toothed Dolphin – Site D

A few strandings and two sightings of rough-toothed dolphin have been recorded in or near the VACAPES OPAREA (DoN, 2008m). 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 OPAREA may follow the western edge of the Gulf Stream. The rough-toothed dolphin may occur in the OPAREA year-round. The rough-toothed dolphin is expected to occur seaward of the shelf break in the Site D USWTR site.

Bottlenose Dolphin – Site D

The range of offshore bottlenose dolphins may extend into deeper waters (Wells et al., 1999), including the Hatteras Abyssal Plain just southeast of the VACAPES OPAREA. Due to the lack of complete survey effort in offshore waters of the VACAPES OPAREA, occurrence of the offshore stock is likely not well represented here (DoN, 2008m). The bottlenose dolphin may occur in the OPAREA year-round. The bottlenose dolphin is expected to occur in the Site D USWTR.

Atlantic Spotted Dolphin – Site D

In the Atlantic, Atlantic spotted dolphin is considered broadly sympatric with pantropical spotted dolphins (Perrin and Hohn, 1994). The offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea. Therefore, the low number of sightings of Atlantic spotted dolphins in offshore waters of the VACAPES OPAREA may be more of a reflection of survey observers not distinguishing between the two species (DoN, 2008m). Atlantic spotted dolphins may occur in continental shelf and offshore waters throughout the VACAPES OPAREA. The Atlantic spotted dolphin is expected to occur in the Site D USWTR.

Pantropical Spotted Dolphin – Site D

The low number of sightings of pantropical spotted dolphins in offshore waters of the VACAPES OPAREA may be more of a reflection of survey observers not distinguishing between the Atlantic spotted and pantropical spotted dolphins (DoN, 2008m). Based on sighting data and known habitat preferences, pantropical spotted dolphins may occur seaward of the shelf break throughout the VACAPES OPAREA and the Site D USWTR.

Spinner Dolphin – Site D

Several stranding, sighting, and bycatch records of the spinner dolphin are documented in or near the OPAREA (DoN, 2008m). Spinner dolphins prefer warm, offshore waters as evidenced by the sighting and bycatch records associated with the Gulf Stream in the winter and spring months. Spinner dolphin may occur from the vicinity of the continental shelf break to eastward of the VACAPES OPAREA boundary in association with the Gulf Stream's northern boundary. No seasonal differences in occurrence are anticipated. The spinner dolphin is expected to occur in the Site D USWTR.

Clymene Dolphin – Site D

Most Clymene dolphin sightings in or near the VACAPES OPAREA are recorded in offshore waters over the continental slope and follow the path of the Gulf Stream (DoN, 2008m). The oceanographic features of the Gulf Stream likely influence the distribution of Clymene dolphins in this region. Based on confirmed sightings and the preference of this species for warm, deep waters, Clymene dolphins are expected in waters seaward of the shelf break south of the northern wall of the Gulf Stream. Only two sightings (both during summer) are documented north of the Gulf Stream in the OPAREA (DoN, 2008m). Clymene dolphins may occur north of the Gulf Stream's warm water influence, particularly during summer when water temperatures are generally warmer. The Clymene dolphin may occur seaward of the shelf break in the Site D USWTR.

Striped Dolphin – Site D

As noted earlier, the striped dolphin is a deep water species that is generally distributed north of Cape Hatteras (CETAP, 1982), which is supported by the distribution of sightings in the VACAPES OPAREA. The southern edge of this species' predicted occurrence in the VACAPES OPAREA appears to be influenced by meanderings of the Gulf Stream (DoN, 2008m). Sightings predominately occur along the Gulf Stream's northern wall, where it travels through the southern part of the VACAPES OPAREA. Occurrence is expected near and seaward of the shelf break throughout the OPAREA year-round. The striped dolphin may occur near and seaward of the shelf break in the Site D USWTR.

Common Dolphin – Site D

Common dolphins primarily occur in a broad band along the shelf break from Cape Hatteras to Nova Scotia year-round (CETAP, 1982). The common dolphin occurs year-round in the VACAPES OPAREA, with the most sightings and strandings recorded in winter and spring (DoN, 2008m). Common dolphins may occur throughout the OPAREA year-round. The common dolphin is expected to occur in the Site D USWTR.

Fraser's Dolphin – Site D

Fraser's dolphin, a deepwater species, is found in the tropical waters of the world. Only one sighting is documented in the VACAPES OPAREA; this sighting was recorded in deep waters (>3,000 m in depth) offshore of Cape Hatteras (NMFS-SEFSC, 1999). Fraser's dolphins may occur seaward of the shelf break throughout the OPAREA year-round. The Fraser's may occur near and seaward of the shelf break in the Site D USWTR.

White-beaked Dolphin – Site D

The white-beaked dolphin is found in the North Atlantic, in cold-temperate and subarctic waters. Any occurrences of the white-beaked dolphin in the VACAPES OPAREA are considered to be extralimital (DoN, 2008m). One sighting record is documented in the OPAREA along the shelf break during spring (DoN, 2008m). Based on the habitat preferences of this species, the white-beaked dolphin may occur very rarely in waters between the shoreline and the 2,000 m (6,562 ft) isobath throughout the OPAREA. The white-beaked dolphin is not expected to occur in the vicinity of the 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.

Risso's Dolphin – 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 Site D USWTR year-round.

Melon-headed Whale – Site D

Melon-headed and pygmy killer whales can be difficult to distinguish from one another, and on many occasions only a determination of "pygmy killer whale/melon-headed whale" can be made. Two sightings of melon-headed whales are recorded in deep (>2,500 m [>8,200 ft]) offshore waters along the path of the Gulf Stream in the southern VACAPES OPAREA (DoN, 2008m). Based on warm water preferences, melon-headed whale occurrence in the OPAREA during winter is likely influenced by the Gulf Stream. The melon-headed whale is an oceanic species, which may occur seaward of the shelf break year-round throughout the VACAPES OPAREA. The melon-headed whale may occur near and seaward of the shelf break in the Site D USWTR.

Pygmy Killer Whale – Site D

Only one confirmed record, a fall stranding north of Cape Hatteras, is documented for pygmy killer whales in the VACAPES OPAREA and vicinity (DoN, 2008m). The pygmy killer whale is an oceanic species; which may occur seaward of the shelf break year-round throughout the VACAPES OPAREA. Based on warm water preferences, pygmy killer whale occurrence in the OPAREA during winter is likely influenced by the Gulf Stream. The pygmy killer whale may occur near and seaward of the shelf break in the Site D USWTR.

False Killer Whale – Site D

False killer whales occur in offshore, warm waters worldwide (Baird, 2002). The warm waters of the Gulf Stream likely influence their occurrence in the southern VACAPES OPAREA. A small number of sightings and strandings are recorded near the OPAREA; the sightings reflect the preference of this species for offshore waters (DoN, 2008m). False killer whales may occur seaward of the shelf break throughout the OPAREA year-round. The false killer whale may occur near and seaward of the shelf break in the Site D USWTR.

Killer Whale – Site D

Several killer whale sightings are recorded in both shallow and deep waters of the VACAPES OPAREA and vicinity (DoN, 2008m). Strandings are also reported along the Outer Banks (DoN, 2008m). Killer whales may occur throughout the OPAREA and vicinity year-round based on sighting data and the diverse habitat preferences of this species. They may occur throughout the Site D USWTR.

Long-finned and Short-finned Pilot Whales – Site D

The VACAPES OPAREA is located in a region of range overlap between both pilot whale species (Payne and Heinemann, 1993). Identification of pilot whales to species is difficult at sea, and identification is often made to the genus level only. All seasons support sighting and bycatch records of unidentified pilot whales (likely short-finned pilot whales) in Gulf Stream waters of the VACAPES OPAREA due to the tropical nature of this species (DoN, 2008m).

Throughout the year, pilot whales may occur in waters with steep bottom topography (i.e., canyons and steep slope areas) which are likely feeding areas. These areas also follow the path of the Gulf Stream. Pilot whales are often sighted along the northern wall of the Gulf Stream which is a region of enhanced productivity. Both species of pilot whale may occur in the VACAPES OPAREA and the Site D USWTR year-round.

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.

Pinnipeds (Seals) – Site D

Blaylock et al. (1995) report that four seal species are known to occur in the western North Atlantic Ocean: harbor seal, gray seal, harp seal, and hooded seal. Stranding records show a considerable dropoff in the sighting of seals south of the New Jersey/Delaware area. Winn et al. (1979) suggested that harbor seals found in this area are likely young individuals that disperse from the north during the winter months. Stranding data support a consistent seasonal occurrence of harbor seals in this region (Harry et al., 2005). Most harbor seal strandings near the OPAREA are documented during winter. Between 2000 and 2005, at least 71 records of harbor seal strandings were reported for North Carolina and Virginia (Harry et al., 2005). Most of these strandings occurred between November and April and were of young individuals. Sightings and strandings of harbor seals have been documented throughout the year in South Carolina (McFee, 2006). Therefore, harbor seals may move south and occur along the coast near the VACAPES OPAREA and the Site D USWTR any time of the year (DoN, 2008m). Any occurrences of the gray seal, harp seal, and hooded seal in the VACAPES OPAREA and Site D USWTR are considered to be extralimital (DoN, 2008m).

Sirenians (Manatees) – Site D

There are several unpublished records and personal observations of manatees throughout this region. Manatees have been reported near the OPAREA as far north as the Potomac River (sighting in August 1980) and Buckroe Beach, Hampton City, Chesapeake Bay (a stranding reported in October 1980) (Rathbun et al., 1982). Based on their known habitat preferences, manatees could occur throughout the freshwater, estuarine, and nearshore coastal waters in or near the VACAPES OPAREA year-round; however, any occurrences in the OPAREA or Site D USWTR would be considered extralimital (DoN, 2008m).

3.2.6.5 Cetacean Stranding Events

When a live or dead marine mammal swims or floats onto shore and becomes “beached” or incapable of returning to sea, the event is termed a “stranding” (Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007e). The legal definition for a stranding within the United States is that “a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 USC 421h).

The majority of animals that strand are dead or moribund (i.e., dying) (NMFS, 2007e). For animals that strand alive, human intervention through medical aid and/or guidance seaward may be required for the animal to return to the sea. If unable to return to sea, rehabilitation at an appropriate facility may be determined as the best opportunity for animal survival. An event where animals are found out of their normal habitat is may be considered a stranding depending on circumstances even though animals do not necessarily end up beaching (Southhall, 2006).

Three general categories can be used to describe strandings: single, mass, and unusual mortality events. The most frequent type of stranding is a single stranding, which involves only one animal (or a mother/calf pair) (NMFS, 2007e).

A mass stranding involves two or more marine mammals of the same species other than a mother/calf pair (Wilkinson, 1991), and may span one or more days and range over several miles (Simmonds and Lopez-Jurado, 1991; Frantzis, 1998; Walsh et al., 2001; Freitas, 2004). In North America, only a few species typically strand in large groups of 15 or more and include sperm whales, pilot whales, false killer whales, Atlantic white-sided dolphins, white-beaked dolphins, and rough-toothed dolphins (Odell, 1987; Walsh et al., 2001). Some species, such as pilot whales, false-killer whales, and melon-headed whales, occasionally strand in groups of 50 to 150 or more (Geraci et al., 1999). All of these normally pelagic off-shore species are highly sociable and are usually infrequently encountered in coastal waters. Species that commonly strand in smaller numbers include pygmy killer whales, common dolphins, bottlenose dolphins, Pacific white sided dolphins, Frasier's dolphins, gray whales and humpback whales (west coast only), harbor porpoise, Cuvier's beaked whales, California sea lions, and harbor seals (Mazzuca et al., 1999, Norman et al., 2004, Geraci and Lounsbury, 2005).

Unusual mortality events (UMEs) can be a series of single strandings or mass strandings, or unexpected mortalities (i.e., die-offs) that occur under unusual circumstances (Dierauf and Gulland, 2001; Harwood, 2001; Gulland, 2006; NMFS, 2007e). These events may be interrelated: for instance, at-sea die-offs lead to increased stranding frequency over a short period of time, generally within one to two months. As published by the NMFS, revised criteria for defining a UME include the following (Hohn et al., 2006):

- A marked increase in the magnitude or a marked change in the nature of morbidity, mortality, or strandings when compared with prior records
- A temporal change in morbidity, mortality, or strandings is occurring
- A spatial change in morbidity, mortality, or strandings is occurring

- Difference in species, age, or sex composition of the affected animals from that of animals that are normally affected

- Similar or unusual pathologic findings, behavior patterns, clinical signs, or general physical condition (e.g., blubber thickness) in affected animals

- Potentially significant morbidity, mortality, or stranding observed in species, stocks, or populations that are particularly vulnerable (e.g., listed as depleted, threatened or endangered or declining). For example, stranding of three or four right whales may be cause for great concern whereas stranding of a similar number of fin whales may not.

- Morbidity observed concurrent with or as part of an unexplained continual decline of a marine mammal population, stock, or species

UMEs are usually unexpected, infrequent, and may involve a significant number of marine mammal mortalities. As discussed below, unusual environmental conditions are probably responsible for most UMEs and marine mammal die-offs (Vidal and Gallo-Reynoso, 1996; Geraci et al., 1999; Walsh et al., 2001; Gulland and Hall, 2005).

Reports of marine mammal strandings can be traced back to ancient Greece (Walsh et al., 2001). Like any wildlife population, there are normal background mortality rates that influence marine mammal population dynamics, including starvation, predation, aging, reproductive success, and disease (Geraci et al., 1999; Carretta et al., 2007). Strandings in and of themselves may be reflective of this natural cycle or, more recently, may be the result of anthropogenic sources (i.e., human impacts). Current science suggests that multiple factors, both natural and man-made, may be acting alone or in combination to cause a marine mammal to strand (Geraci et al., 1999; Culik, 2002; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NRC, 2006). Appendix E of this final OEIS/EIS contains a detailed discussion of potential causes of stranding.

While post- stranding data collection and necropsies of dead animals are attempted in an effort to find a possible cause for the stranding, it is often difficult to pinpoint exactly one factor that can be blamed for any given stranding. An animal suffering from one ailment becomes susceptible to various other influences because of its weakened condition, making it difficult to determine a primary cause. In many stranding cases, scientists never learn the exact reason for the stranding. Specific potential stranding causes can include both natural and human influenced (anthropogenic) causes as listed below:

- Natural stranding causes
  - disease
  - natural toxins
  - weather and climatic influences
  - navigation errors
  - social cohesion

  - predation

- Human-influenced (anthropogenic) stranding causes
  - fisheries interaction
  - vessel strike
  - pollution and ingestion
  - noise

Specific beaked whale stranding events that may be associated with naval operations are as follows:

- May 1996: Greece (NATO/U.S.)
- March 2000: Bahamas (U.S.)
- May 2000: Portugal, Madeira Islands (NATO/U.S.)
- September 2002: Spain, Canary Islands (NATO/U.S.)
- January 2006: Spain, Mediterranean Sea coast (NATO/U.S.)

As discussed in Appendix E, Cetacean Stranding Report, these stranding events represent a small overall number of animals (40 animals) over an 11 year period. While beaked whale strandings have been documented since the 1800s (Geraci and Lounsbury, 1993; Cox et al., 2006; Podesta et al., 2006), the state of science can not yet determine if a sound source such as mid-frequency sonar alone causes beaked whale strandings, or if other factors (acoustic, biological, or environmental) must co-occur in conjunction with a sound source (Cox et al., 2006). Four (Greece, Portugal, Spain [twice]) of the five events listed above occurred during NATO exercises or events where DON presence was limited. One (Bahamas) of the five events involved only DoN ships. These five events are described briefly below.

- May 1996 Greece - Twelve Cuvier's beaked whales (*Ziphius cavirostris*) stranded along the coast of the Kyparissiakos Gulf on May 12 and 13, 1996 (Frantzis, 1998). From May 11 through May 15, the NATO research vessel Alliance was conducting sonar tests with signals of 600 Hz and 3 kHz and root-mean-squared (rms) sound pressure levels (SPL) of 228 and 226 dB re: 1µPa, respectively (D'Amico and Verboom, 1998; D'Spain et al., 2006). The timing and the location of the testing encompassed the time and location of the whale strandings (Frantzis, 1998). However, because information for the necropsies was incomplete and inconclusive, the cause of the stranding cannot be precisely determined (Frantzis, 1998).

- March 2000, Bahamas – Seventeen marine mammals comprised of Cuvier's beaked whales, Blainville's beaked whales (*Mesoplodon densirostris*), minke whales (*Balaenoptera acutorostrata*), and one spotted dolphin (*Stenella frontalis*), stranded along the Northeast and Northwest Providence Channels of the Bahamas Islands on March 15-16, 2000 (Evans and England, 2001). The strandings occurred over a 36-hour period and coincided with DON use of mid-frequency active sonar within the channel. Navy ships were involved in tactical sonar exercises for approximately 16 hours on March 15. The ships, which operated the AN/SQS-53C and AN/SQS-56, moved through the channel while emitting sonar pings approximately every 24 seconds. The timing of pings was staggered between ships and average source levels of pings varied from a nominal 235 dB SPL (AN/SQS-53C) to 223 dB SPL (AN/SQS-56). The center frequency of pings was 3.3 kHz. Passive acoustic monitoring records demonstrated that no large scale acoustic activity besides the Navy sonar exercise occurred in the times surrounding the stranding event. The mechanism by which sonar could have caused the observed traumas or caused the animals to strand was undetermined (Evans and England, 2001).

- May 2000, Madeira Island, Portugal – Three Cuvier's beaked whales stranded on two islands in the Madeira Archipelago, Portugal, from May 10 – 14, 2000 (Cox et al., 2006). A joint NATO amphibious training exercise, named "Linked Seas 2000," which involved participants from 17 countries, took place in Portugal during May 2 – 15, 2000. The timing and location of the exercises overlapped with that of the stranding incident. Although the details about whether or how sonar was used during "Linked Seas 2000" is unknown, the presence of naval activity within the region at the time of the strandings suggested a possible relationship to Navy activity.

- September 2002, Canary Islands, Spain – On September 24, 2002, 14 beaked whales stranded on Fuerteventura and Lanzaote Islands in the Canary Islands (Jepson et al., 2003). At the time of the strandings, an international naval exercise, NATO exercise Neo-Tapon 2002 (Fernández et al., 2005), which involved numerous surface warships and several submarines was being conducted off the coast of the Canary Islands. Tactical mid-frequency active sonar was utilized during the exercises, and strandings began within hours of the onset of the use of mid-frequency sonar (Fernández et al., 2005). The association of NATO mid-frequency sonar use close in space and time to the beaked whale strandings, and the similarity between this stranding event and previous beaked whale mass strandings coincident with sonar use suggests that a similar scenario and causative mechanism of stranding may be shared between the events.

- January 2006, Spain – The Spanish Cetacean Society reported an atypical mass stranding of four beaked whales that occurred January 26 to 28, 2006, on the southeast coast of Spain near Mojacar (Gulf of Vera) in the Western Mediterranean Sea. From January 25-26, 2006, a NATO surface ship group (seven ships including one U.S. ship under NATO operational command) conducted active sonar training against a Spanish submarine within 50 nm of the stranding site. According to the pathologists, a likely cause of this type of beaked whale mass stranding event may have been anthropogenic acoustic activities.

However, no detailed pathological results confirming this supposition have been published to date, and no positive acoustic link was established as a direct cause of the stranding when evaluated in conjunction with NATO activities.

Potential impacts to all species of cetaceans worldwide from fishery related mortality can be orders of magnitude more significant than those believed to be related to sonar activity (100,000s of animals versus 10s of animals) (Culik, 2002; ICES, 2005b; Read et al., 2006). This does not negate the influence of any mortality or additional stressor to small, regionalized sub-populations which may be at greater risk from human related mortalities (fishing, vessel strike, sound) than populations with larger oceanic level distribution or migrations. ICES (2005a) noted, however, that taken in context of marine mammal populations in general, sonar is not a major threat, or significant portion of the overall ocean noise budget. A constructive framework and continued research based on sound scientific principles is needed in order to avoid speculation as to stranding causes, and to further our understanding of potential effects or lack of effects from military mid-frequency sonar (Bradshaw et al., 2006; ICES, 2005b; Barlow and Gisiner, 2006; Cox et al., 2006).

3.2.7 Seabirds and Migratory Birds

Seabirds are birds whose normal habitat and food source is the sea, whether they utilize coastal waters (nearshore), offshore waters (continental shelf), or pelagic waters (open sea) (Harrison, 1983). Pelagic birds can be divided into three groups based on breeding and foraging habitat:

- Species such as albatrosses, petrels, frigatebirds, tropicbirds, boobies, and some terns that forage over the ocean and nest on oceanic islands.
- Species such as pelicans, cormorants, gulls, and some terns that nest along the coast and forage in nearshore areas.
- Those few species such as skuas, jaegers, Franklin's gull, Bonaparte's gull, ring-billed gull, and black tern that nest and forage in inland habitats and come to the coastal areas during non-breeding seasons (Schreiber and Burger, 2002).

Seabirds can forage considerable distances; some albatross and petrel species are known to travel hundreds of kilometers on single foraging trips. Several species exhibit dominant or secondary feeding behavior that would place them in the vicinities of the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs. Table 3.2-4 lists the seabirds that are known to utilize the coastal and offshore waters in the four OPAREAs at various times of the year.

While some seabirds are permanent residents to an area, other seabirds migrate to the area annually. Specifically, a migratory bird is any species or family of birds that live, reproduce, or migrate within or across international borders at some point during its annual life cycle. As discussed in Subchapter 1.6, migratory birds are protected under the MBTA. Virginia, North Carolina, South Carolina, and Florida lie within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds utilize the flyway. The coastal route of the Atlantic Flyway generally follows the shoreline, and migratory birds are typically associated with the coast. The four USWTR sites, A, B, C, and D, are located offshore from the principal routes of migratory birds.

Foraging Habits

Overall, the majority of birds likely to occur in the USTWR Site areas feed in shallow waters and typically do not fully submerge themselves in the water. Rather, these seabirds plunge-dive from the air into the water and feed by aerial dipping (taking food from the water surface in flight) (Slotterback, 2002). Other common feeding methods include surface-seizing (sitting on water and taking food from surface), surface-dipping (swimming and then dipping to pick up items below the surface), jump-plunging (swimming, then jumping upward and diving under water), or picking up food while walking (Burger and Gochfeld, 2002). For example, shearwaters and petrels tend to skim waves in search of food, while the majority of gull and tern species eat only small fish and feed by plunge-diving head-first from flight, often from a hovering position (National Geographic, 2002; MMS, 2007h). The gull-billed tern and sooty tern, however, pluck food from the water's surface (MMS, 2007h). Diving birds such as cormorants, loons, and grebes generally feed by pushing themselves underwater with their wings and/or feet.

For seabirds that dive for food that are found in the OPAREAs, research indicates that the longest recorded dive time was 28 seconds for the double-crested cormorant, which also had a minimum dive time of 19 seconds (Hatch and Weseloh, 1999). Maximum dive depths for species in the areas were 12 m (39 ft) for the pied-billed grebe (Muller and Storer, 1999), and 8 m (26 ft) for the double-crested cormorant (Hatch and Weseloh, 1999). The average dive length for the double-crested cormorant was approximately 5 m (16 ft) (Hatch and Weseloh, 1999). A representative overview of foraging habits for birds likely to occur in the USWTR OPAREAs is presented in Table 3-2.5.

Table 3.2-4

Seabirds Occurring in the OPAREAs

Family	Common Name	Scientific Name	OPAREAs			
			JAX	CHASN	CHPT	VACAPES
Diomedeidae	Yellow-nosed albatross	*Thalassarche chlororhynchos*	R	R	R	R
Procellariidae	Herald petrel	*Pterodroma arminjoniana*	0	0	R (May-Sep)	R (May-Sep)
	Fea's petrel	*Pterodroma feae*	R	R	May- Fall	May- Fall
	Bermuda petrel	*Pterodroma cahow*	0	0	May- Aug	May-Aug
	Black-capped petrel	*Pterodroma hasitata*	May- Oct	May- Oct	May- Oct	May-Oct
	Cory's shearwater	*Calonectris diomedea*	May- Nov	May- Nov	May- Nov	May- Nov
	Greater shearwater	*Puffinus gravis*	Mar-Jun	Mar-Jun	Mar-Jun	Mar-Jun
	Sooty shearwater	*Puffinus griseus*	Spring	Spring	Spring	Spring
	Manx shearwater	*Puffinus puffinus*	R (winter)	R (winter)	R (winter)	Jun-Oct
	Audubon's shearwater	*Puffinus lherminieri*	May-Oct R(winter)	May-Oct R(winter)	May-Oct	May-Oct
Hydrobatidae	Wilson's storm-petrel	*Oceanites oceanicus*	May-Sep	May-Sep	May-Sep	May-Sep
	White-faced storm-petrel	*Pelagodroma marina*	0	0	R	R
	Leach's storm-petrel	*Oceanodroma leucorhoa*	S	S	S	S
	Band-rumped storm-petrel	*Oceanodroma castro*	May-Aug	May-Aug	May-Aug	May-Aug
Phaethontidae	White-tailed tropicbird	*Phaethon lepturus*	May-Aug	May-Aug	May-Aug	May-Aug
	Red-billed tropicbird	*Phaethon aethereus*	R (May-Aug)	R (May-Aug)	R (May-Aug)	R (May-Aug)
Sulidae	Masked booby	*Sula dactylatra*	A	A	Apr-Oct	Apr-Oct
	Brown booby	*Sula leucogaster*	R	R	R	R

Table 3.2-4 (cont'd)

Seabirds Occurring in the OPAREAs

Family	Common Name	Scientific Name	OPAREAs			
			JAX	CHASN	CHPT	VACAPES
Pelecanidae	Brown pelican	*Pelecanus occidentalis*	A	A	A	A
	American white pelican	*Pelecanus erythrorhynchos*	A	A	R	R
Phalacrocoracidae	Double-crested cormorant	*Phalacrocorax auritus*	A	A	A	A
	Great cormorant	*Phalacrocorax carbo*	Jun-Jan	Jun-Jan	Jun-Jan	Jun-Jan
Fregatidae	Magnificent frigatebird	*Fregata magnificens*	A	A	R(Apr-Sep)	R(Apr-Sep)
Alcidae	Dovekie	*Alle alle*	R (winter)	R (winter)	R (winter)	Oct-Mar
	Razorbill	*Alcoa torda*	R (winter)	R (winter)	R (winter)	Sep-Feb
	Common murre	*Uria aalge*	0	0	0	R (Sep – Mar)
	Thick-billed murre	*Uria lomvia*	R (winter)	R (winter)	R (winter)	Oct-Mar
	Black guillemot	*Cepphus grille*	0	0	0	R (winter)
	Atlantic puffin	*Fratercula artica*	0	0	0	Sep-Feb
Laridae	Black-legged kittiwake	*Rissa tridactyla*	Aug-Mar	Aug-Mar	Aug-Mar	Aug-Mar
	Long-tailed jaeger	*Stercorarius longicaudus*	R	R	Nov-Mar	Nov-Mar
	Parasitic jaeger	*Stercorarius parasiticus*	Sep-May	Sep-May	Sep-May	Spring/Fall
	Pomarine jaeger	*Stercorarius pomarinus*	Sep-May	Sep-May	Sep-May	Spring/Fall
	South Polar skua	*Stercorarius maccormicki*	R (May-Oct)	R (May-Oct)	May-Oct	May-Oct
	Great skua	*Stercorarius skua*	0	0	Nov-Apr	Nov-Apr
	Laughing gull	*Larus atricilla*	A	A	A	A
	Herring gull	*Larus argentatus*	A	A	A	A
	Great black-backed gull	*Larus marinus*	A	A	A	A

Table 3.2-4 (cont'd)

Seabirds Occurring in the OPAREAs

Family	Common Name	Scientific Name	OPAREAs			
			JAX	CHASN	CHPT	VACAPES
Laridae	Black-headed gull	*Larus ridibundus*	R	R	R	R
	Bonaparte's gull	*Larus philadelphia*	Jan-Jun	Jan-Jun	Jan-Jun	Jan-Jun
	Lesser black-backed gull	*Larus fuscus*	Sep-Mar	Sep-Mar	Sep-Mar	Sep-Mar
	Little gull	*Larus minutus*	Sep-Mar	Sep-Mar	Sep-Mar	Sep-Mar
	Ring-billed gull	*Larus delawarensis*	Jun-Mar	Jun-Mar	Jun-Mar	Jun-Mar
	Glaucous gull	*Larus hyperboreus*	Sep-May	Sep-May	Sep-May	Sep-May
	Iceland gull	*Larus glaucoides*	R	R	R	Nov-Mar
	Thayer's gull	*Larus thayeri*	R (Dec-Mar)	R (Dec-Mar)	R (Dec-Mar)	R (Dec-Mar)
	Roseate tern	*Sterna dougallii*	R	R	R	R
	Gull-billed tern	*Sterna nilotica*	A	A	May-Jul	May-Jul
	Caspian tern	*Sterna caspia*	A	A	A	A
	Royal tern	*Sterna maxima*	A	A	A	A
	Sandwich tern	*Sterna sandvicensis*	May-Jul	May-Jul	May-Jul	May-Jul
	Common tern	*Sterna hirundo*	May-Jul	May-Jul	May-Jul	May-Jul
	Forster's tern	*Sterna forsteri*	A	A	A	A
	Least tern	*Sterna antillarum*	May-Jun	May-Jun	May-Jun	May-Jun
	Bridled tern	*Sterna anaethetus*	R (Jun-Sep)	R (Jun-Sep)	R	R
	Sooty tern	*Sterna fuscata*	R (Jun-Sep)	R (Jun-Sep)	R	R
	Brown Noddy	*Anous stolidus*	R	R	R	R

Notes: A = all year; S = summer; R = rare occurrence; 0 = does not occur.
Source: DoN, 2007d.

Table 3.2-5

Foraging Habits of Seabirds Occurring in OPAREAs

Bird	Food Selection	Food Location of Feeding	Feeding Behavior
Band-Rumped Storm Petrels *(Oceanodroma castro)*	Squid and small fish from ocean surface; few crustaceans	Internal wave crests at or just below surface	Aerial dipping
Bonaparte's Gulls *(Larus philadelphia)*	Small fish, krill, amphipods, and insects such as snails, marine worms, grasshoppers, beetles, locusts, ants, and bees	shallow (< 0.9 m [3 ft]) habitats including lakes, ponds, muskegs, rivers, large bays, coastal estuaries, tidal rips, surf, and open ocean	Plunge-diving, aerial dipping, surface-seizing, surface-dipping, jump-plunging, and walking
Bridled Terns *(Sterna anaethetus)*	Primarily small schools of fish near the ocean's surface, crustaceans, and	Air-sea boundary layer, typically 0.9 to 2.1 m (3 to 7 ft) above and on sea surface	Aerial dipping (pecking)
Brown Pelicans *(Pelecanus occidentalis)*	Primarily small schools of fish near the ocean's surface such as menhaden and mullet along Atlantic and Gulf Coasts	Shallow habitats within 20 km (11 NM) of shore	Plunge-dives and aerial dipping
Double-Crested Cormorants *(Phalacrocorax auritus)*	Mostly slow-moving schooling species; occasionally insects, amphibians, and crustaceans	Shallow open water (< 7.9 m [26 ft] deep) and close to shore (< 5.6 km [3 NM])	Plunge-diving
Forster's Tern *(Sterna forsteri)*	Primarily small fish; some arthropods	Shallow saltwater estuaries and coastal areas (< 3 ft), over flood-tide mudflats, marshes, lakes, and water channels	Aerial dipping
Gull Billed Terns *(Sterna nilotica)*	Terrestrial and aquatic animals such as insects, lizards, fish, and chicks of other birds	Beaches and salt marshes, inland over plowed fields, and shrubby habitats	Does not generally plunge-dive; Instead plucks food from the water
Horned Grebes *(Podiceps auritus)*	Fish and crustaceans, including amphipods and crayfish	Shallow- to moderately deep (<6.1 m [20 ft]) habitats	Surface-swimming and plunge-diving
Laughing Gulls *(Larus atricilla)*	Aquatic and terrestrial invertebrates such as earthworms, flying insects, beetles, snails, crabs, fish, and squid;; garbage; and berries	Coastal edge and inland	Surface-dipping, walking, plunge-diving, and pirating food from other species

Table 3.2-5 (cont'd)

Foraging Habits of Seabirds Occurring in OPAREAs

Bird	Food Selection	Food Location of Feeding	Feeding Behavior
Least Terns *(Sterna antillarum)*	Small fish, shrimp, and other invertebrates	Shallow water habitats such as marine coasts, bays, lagoons, estuaries, river and creek mouths, tidal marshes, and lakes	Plunge-diving
Parasitic Jaegers *(Stercorarius parasiticus)*	Depends on breeding populations, but can include birds, eggs, and rodents	Near colonies of nesting seabirds	Plunge-diving and pirating food from other species
Sandwich Terns *(Sterna sandvicensis)*	Small marine fish, squid, and crustaceans	Coastal marine areas such as open ocean and bays, inlets, and outflows; usually < 1.9 km [1 NM] off shore	Plunge-diving
Sooty Terns *(Sterna fuscata)*	Small pelagic fish and squid; feeds over large predatory fish including tuna	Within 10 cm (4 in) of the ocean surface, far at sea in tropical, and subtropical oceanic waters	Plunge-diving
Sources: Braune, 1987, Slotterback, 2002; Burger and Gochfeld, 2002; Burger and Gochfeld, 1996; Haney et al., 1999; Shields, 2002; Hatch and Weseloh, 1999; McNicholl et al., 2001; Parnell et al., 1995; Palmer, 1962; Stedman, 2000; Burger, 1996; Thompson et al., 1997; Wiley and Lee, 1999; Muller and Storer, 1999; Shealer, 1999; Schreiber et al., 2002.			

3.2.8 Endangered and Threatened Species

Section 7(a)(2) of the ESA of 1973 (as amended in 1978 and 1982) requires federal agencies to ensure that their actions do not jeopardize the continued existence of any listed endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. A species is considered "endangered" if it is in danger of extinction throughout all or a significant portion of its range, and "threatened" if it is likely to become endangered in the foreseeable future due to any of the following factors (Section 4(a)(1)(A – E), 1982 amendment):

- Present or threatened destruction, modification, or curtailment of its habitat or range
- Overutilization for commercial, recreational, scientific, or educational purposes
- Disease or predation
- Inadequacy of existing regulatory mechanisms
- Other natural or manmade factors affecting its continued existence.

3.2.8.1 Fish

This section discusses ESA-listed fish species, candidate species for ESA-listing, and species of concern whose distribution overlaps at least one of the four proposed USWTR range sites or trunk cable corridors. Appendix A provides tables of fish species that may occur in each of the four range sites and/or cable corridors, including the species covered in this section. Candidate ESA species have sufficient information on their biological status and threats available to propose them as endangered or threatened under the ESA, but the development of a proposed listing regulation is precluded by other higher priority listing activities (USFWS, 2009).

3.2.8.1.1 ESA Species

Federally endangered or candidate fish with distribution ranges that overlap at least one of the four proposed USWTR locations or their trunk cable areas are:

- Shortnose sturgeon, *Acipenser brevirostrum*
- Smalltooth sawfish, *Pristis pectinata*
- Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus* (candidate species)

Shortnose Sturgeon

The endangered shortnose sturgeon is an anadromous species that does not appear to make long distance offshore migrations. Shortnose sturgeon occur in most major river systems along the eastern seaboard of the United States. In the southern portion of their range, they are found in the St. Johns River in Florida; the Altamaha, Ogeechee, and Savannah Rivers in Georgia; and, in South Carolina, in the river systems that empty into Winyah Bay and the Santee/Cooper River complex that forms Lake Marion. Data are lacking for the rivers of North Carolina. In the northern portion of their range, shortnose sturgeon are found in the Chesapeake Bay system; the

Delaware River from Philadelphia, Pennsylvania, to Trenton, New Jersey; the Hudson River in New York; the Connecticut River; the lower Merrimack River in Massachusetts; the Piscataqua River in New Hampshire; the Kennebec River in Maine; and the St. John River in New Brunswick, Canada (NMFS, 1998d).

South of Chesapeake Bay, the largest sustaining populations of shortnose sturgeon inhabit rivers, bays/sounds, and nearshore areas in the vicinity of river mouths (Moser and Ross, 1995; Collins et al., 1996; Collins and Smith, 1997; Hoehn, 1998; Collins et al., 2002; Center for Biological Diversity, 2007). These southern populations are relatively small, with estimated adult populations ranging from fewer than 50 (i.e., Cape Fear River) to more than 1,000 individuals (i.e., Savannah and Altamaha rivers) (Center for Biological Diversity, 2007). These include the following populations:

- Savannah River, South Carolina, and Altamaha River, Georgia (>1,000 fish)
- Winyah Bay, South Carolina/North Carolina, and Ogeechee River, Georgia (<1,000 fish)
- Cape Fear River drainage, North Carolina; Santee and Cooper rivers/ Ashepoo, Combahee, and Edisto rivers ("ACE" Basin), South Carolina; Satilla River, Georgia; and St. Marys and St. Johns rivers, Florida (<100 fish)

Shortnose sturgeon appear to spend most of their life in their natal river systems, only occasionally entering the marine environment. When captured in the ocean, they are usually taken close to shore (NMFS, 1998d). Therefore, they are not expected to be found as far offshore as the range sites and occurrence in the offshore portions of the trunk cable corridor would be rare.

With respect to the USWTR Site A, shortnose sturgeon are extremely rare and restricted to the lower St. Johns River basin from the Atlantic Ocean upstream to Lake George and Lake Crescent (Hoehn, 1998). The Florida Fish and Wildlife Research Institute (FWRI) and USFWS began research on the population status and distribution of the species in St. Johns River in 2001. After approximately 4,500 hours of gill-net sampling of the estuarine section of the river (between the confluence of the Oklawaha River below Lake George and Jacksonville) from January through August of 2002 and 2003, only one shortnose sturgeon was captured, near Federal Point between Palatka and Bostwick (FFWCC-FWRI, 2007b). In addition, after 21,381 hours of gill-net sampling for other species from 1980 through 1993, there were no incidental captures of sturgeon (FFWCC-FWRI, 2007b). Based on a lack of suitable reproductive habitat (required rocky or gravel substrate or limestone outcroppings), reproduction documentation, occurrence of specimens in numerous thermal refuges (springs), and lack of large adults (all known specimens have been less than 4.5 kg [10 lbs]), it is highly unlikely that any sizable population of the shortnose sturgeon currently exists in the St. Johns River or its tributaries (FFWCC-FWRI, 2007b). Given this marginal habitat and low population density, it can be determined that the shortnose sturgeon has not actively spawned in the system and that the infrequent catches are transients from other river systems (FFWCC, 2005d; Holder, 2007).

Since the current distribution of this species is in estuarine/coastal areas, and because the species has not been reported other than in coastal areas, except on extremely rare occasions, the shortnose sturgeon is not expected to be present within the USWTR range at any of the sites. The shortnose sturgeon may occur in nearshore areas of the trunk cable corridor area at all sites, although these occurrences would be rare based on the limited number of individuals observed in these areas.

Smalltooth Sawfish

The endangered smalltooth sawfish was once prevalent throughout Florida waters and found from Texas to North Carolina. However, the current Atlantic range is limited to areas south of St. John’s County, Florida through the Florida Keys (NMFS, 2006o), with the highest concentrations in areas around the marine and estuarine sections of the Everglades National Park (Simpfendorfer and Wiley, 2006). The Mote Marine Laboratory Sawfish Encounter Database had 667 verified smalltooth sawfish encounters from 1999 to 2005, with the vast majority occurring within Florida waters (Simpfendorfer and Wiley, 2006). Most of the Florida east coast encounters occur south of 27°N, from Cape Canaveral to St. Lucie Inlet (Simpfendorfer and Wiley, 2005b). No encounters were recorded in the Site A USWTR range or corridor.

Sawfish, in general, inhabit the shallow coastal waters of most warm seas throughout the world. They are found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 10 m (32 ft). They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths (NMFS, 2006o). The current distribution of the smalltooth sawfish is limited to peninsular Florida, and because the species is rarely found offshore or north of St. Augustine, Florida, the smalltooth sawfish is not expected to occur within any of the USWTR trunk cable corridor areas or within the boundaries of any of the proposed range sites.

Atlantic Sturgeon

Atlantic sturgeon is a candidate species that ranges from Canada to Florida. It is also listed as a species of concern (NMFS, 2009d). Populations of the Atlantic sturgeon declined under heavy fishing pressure from the 1950s to the 1990s, when a federal moratorium on harvest was placed in effect (NMFS, 2009f). The Atlantic sturgeon is managed under a specific FMP by the Atlantic States Marine Fisheries Commission (ASFMC) (ASFMC, 1990, 1998, 2006).

Atlantic sturgeon are anadromous and spend most of their adult life in the marine environment. Adults generally migrate upriver from February to March in southern systems and from April to May in mid-Atlantic systems (ASSRT, 2007). Following spawning, females leave for marine environments within four to six weeks after spawning and males leave in fall (NMFS, 2009f).

Atlantic sturgeon deposit their eggs on hard surfaces on the bottom where they adhere for four to six days until hatching (Shepard, 2006). Juvenile sturgeon remain in the freshwater/estuary system for three to five years before migrating to the nearshore coastal marine environment as adults. Data indicate that subadult and adult Atlantic sturgeon may travel widely once they enter the marine environment. Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina (ASSRT, 2007). Atlantic sturgeon are long lived with a lifespan of up to 60 years for females and about 30 years for males (Shepard, 2006).

Atlantic sturgeon are currently found in 35 rivers along the Atlantic coast of the U.S. (NMFS, 2009f), covering the geographic range where the four sites occur. However, they are not expected to be found as far offshore as any of the range sites and occurrence in the inshore area of the trunk cable would be rare at all four sites.

3.2.8.1.2 Species of Concern

The ranges of 11 species of concern overlap at least one of the four proposed range sites or trunk cable corridors. These include:

- Alewife, *Alosa pseudoharengus*
- Atlantic sturgeon (candidate species previously discussed)
- Barndoor skate, *Dipturus laevis*
- Blueback herring, *Alosa aestivalis*
- Dusky shark, *Carcharhinus obscurus*
- Ivory tree coral, *Oculina varicosa*
- Nassau grouper, *Epinephelus striatus*
- Night shark, *Carcharhinus signatus*
- Sand tiger shark, *Carcharias taurus*
- Speckled hind, *Epinephelus drummondhayi*
- Warsaw grouper, *Epinephelus nigritus*

Alewife and Blueback Herring

Alewife and blueback herring are managed collectively as 'river herring' by the FMP for Shad and River Herring, due to the difficulty in distinguishing the two species (VIMS, 2003, ASFMC 2008). Both species are species of concern, collectively support commercial fisheries (VIMS, 2004a, b), and have experienced a 90 percent drop in commercial landings from 1985 to 1998 (ASFMC, 2008). The observed population decline is believed to be due to a combination of freshwater habitat loss and degradation, overfishing, and increased predation from the recovering striped bass population (NMFS, 2007r). Both species are anadromous (VIMS, 2007a, b), spending most of their lives in the marine environment. The breeding habits of the two species do not differ largely, except that the blueback runs later in the season, does not run up as far, and does not spawn until the water is much warmer (Bigelow and Schroeder, 1953).

The alewife occurs from Newfoundland to South Carolina and is most abundant in the mid-Atlantic and Northeast (VIMS, 2007b). Alewife are a highly-migratory, pelagic schooling species (VIMS, 2004a). Alewife spawn in coastal rivers in the southern portions of their range and migrate northward with water temperatures, overwintering in deeper waters further from shore (VIMS, 2004a).

Blueback herring are pelagic schooling fish that are distributed from Canada to the St. Johns River in Florida, with their highest abundance from the Chesapeake Bay and southward (VIMS, 2003, 2004b, 2007a). Blueback herring spawn from late March to mid-May and school at sea the rest of the year, overwintering near the bottom (NMFS, 2007r).

Both blueback herring and alewife are expected to occur in all the range and corridor areas of all four alternative USWTR sites, with the sole exception being that alewife is not expected to occur at Site A, which is beyond the southern extent of its range.

Barndoor Skate

The barndoor skate is a bottomfish ranging from Canada to North Carolina (Packer et al., 2003), but is most commonly found in the Gulf of Maine and southern New England (NMFS, 2007t). Barndoor skate are found over mud, sand and gravel substrates (Bigelow and Schroeder, 1953) at a wide depth distribution (Packer et al., 2003), preferring depths of 10 to 140 m (32 to 460 ft) (NMFS, 2007t). They migrate into shallower and more northern waters in summer (Bigelow and Schroeder, 1953; NMFS. 2007t). The numbers of this slow-growing species have declined, as it is caught as bycatch in commercial trawl nets and scallop dredges (Packer et al., 2003, NMFS, 2007t). It is expected to occur in the range and trunk cable corridor areas of Sites C and D.

Dusky Shark

The dusky shark, also known as the bronze whaler or black whaler, occurs worldwide from the surf zone to depths of 400 m (1,312 ft) (Compagno, 1984a; Branstetter, 2002a). Along the east coast of the U.S., the dusky shark ranges from Massachusetts to the Caribbean Sea (Compagno, 1984a; Castro, 1993). Major nursery areas have been identified in coastal waters from Massachusetts to the South Carolina coast (Castro, 1993; McCandless et al., 2002). The dusky shark undertakes seasonal, temperature-related migrations on both coasts of the U.S., migrating northward in summer as the waters warm and retreating southward in fall (Compagno, 1984a; NMFS, 2003c). Its stock is considered overfished, and is subject to continued recreational overfishing (NMFS, 2006k). It is expected to occur on the range and in trunk cable areas of all four sites.

Ivory Tree Coral

Ivory tree coral ranges from Cape Hatteras, North Carolina to the Caribbean (NMFS, 2007u), forming unique thicket-type structures in hard bottom habitats at depths of approximately 70 to 152 m (223 to 500 ft) (NMFS, 2007u). The main U.S. population of concern is off east-central Florida in an area known as the *Oculina* banks (NMFS, 2007u). Documented ivory tree coral declines have been linked to habitat damage (NMFS, 2007u).

In recent years ivory tree coral has declined in the Onslow Bay area because it has been outcompeted by brown algae (i.e., *Sargassum*, *Dictyopterus*, *Zonaria*, and *Dictyota*), forcing it into deeper, darker water (Miller and Hay, 1996; Street et al., 2005). Ivory tree coral may occur in parts of the proposed trunk cable corridor of Sites A, B, and C.

Nassau Grouper

The Nassau grouper occurs from Puerto Rico to northern North Carolina waters (NMFS, 2008c). They are a top predator and are generally found associated with coral habitats or caves or large overhangs from inshore to a depth of about 100 m (328 ft) (NMFS, 2008c). There is some evidence of specific spawning aggregation sites, disturbance of which could have a strong impact on stocks (NMFS, 2008c). It is illegal to possess Nassau groupers in the U.S., but there is still fishing pressure in the Caribbean (NMFS, 2008c). Recently, the SAFMC established eight Snapper-Grouper MPAs (see Subchapter 3.2.4) to provide protection for species including the slow-growing Nassau grouper. This species may occur in reef habitats within the range and trunk cable area of Sites A, B, and C.

Night Shark

Night sharks inhabit waters from Delaware south to Argentina, including the Gulf of Mexico (Barzan, 1999), and have been recorded making seasonal migrations (Compagno, 1984a). Night sharks are a deepwater species found in depths from 275 to 365 m (900 to 1,200 ft) during the day, migrating up to 185 m (610 ft) at night (Compagno, 1984a; NMFS, 2009c). No information exists on nursery locations for this species (NMFS 1999d). The night shark is listed as a Prohibited Species in the U.S. and is listed as a candidate species (NMFS, 1999d). The species is caught as by-catch on pelagic longline fisheries and subject to continued overfishing pressure due to its low rate of population increase (NMFS 2006k). It is expected to occur in the benthopelagic areas of the range and trunk cable area of Sites A, B, C, and D.

Sand Tiger Shark

In the western Atlantic, the sand tiger shark occurs from Newfoundland to Argentina (NMFS, 2009g). They are generally coastal and found in demersal areas of shallow bays and coral or rocky reefs at depths less than 20 m (66 ft), but also can be found to depths of 191 m (627 ft) over the continental shelf (Compagno 1984b; NMFS 1999d; Branstetter 2002b). The sand tiger shark is managed under the HMS FMP (NMFS, 2009g). In Florida, sand tiger sharks are born from November to February and migrate northward to summer habitat from Delaware Bay to Cape Cod, MA (Castro, 1983). Atlantic populations declined due to shark fishing in the 1980s and 1990s, and this slow-growing and slow-reproducing species has not shown signs of recovering (NMFS, 2009g). It is expected to occur in reef habitats within the range and trunk cable corridor of all four sites.

Speckled Hind

Speckled hind ranges from North Carolina to the Bahamas (Manooch, 1988). It typically inhabits hard bottom habitats in warm waters with depths of 25 to 400 m (82 to 1,312 ft), being most commonly found from 60 to 120 m (197 to 394 ft) (Manooch, 1988; SAFMC, 2007d; 2003). Smaller individuals are found in waters further inshore. Eggs are pelagic and larvae remain in surface waters until maturation, when they migrate to bottom habitats (Manooch, 1988). Adults, which are typically solitary, are found in high and low profile hard bottom habitats (SAFMC 1998a, 2003). Spawning aggregations are formed from July to September offshore with specific locations recorded off South Carolina (Manooch, 1988; SAFMC, 2003). Speckled hind is a species of concern from North Carolina-southward (NMFS, 2004) due to high numbers of bycatch in commercial fisheries and declining catch numbers (NMFS, 2009h). EFH has been designated for the speckled hind under the Final Habitat Plan for the South Atlantic Region by the SAFMC (SAFMC, 1998a), and recent Snapper-Grouper MPAs have been designated to aid in species recovery (see Subchapter 3.2.4). Speckled hind is expected to occur in the demersal habitats within the range and trunk cable corridor of Sites A, B, and C.

Warsaw Grouper

The Warsaw grouper is found from Massachusetts to the Gulf of Mexico, most often being found south of North Carolina (Manooch, 1988; NMFS, 2004; SAFMC, 2003). Adults utilize irregular benthic habitats (steep cliffs, notches, valleys, rocky ledges, and drop-offs) at depths ranging from 55 to 525 m (180 to 1,700 ft) (Manooch, 1988; NMFS, 2009e; SAFMC, 1998a). Juveniles are found closer to shore around jetties or shallow reefs (SAFMC, 2003). Eggs and larvae are pelagic, occurring from North Carolina to the southern tip of Florida (SAFMC, 1998a). Few data exist on the reproductive habits and spawning locations of this species, or if they form spawning aggregations (Coleman et al., 2000). Spawning has been reported off Cuba from April to May (SAFMC, 2003). Warsaw groupers are caught as incidental catch in the deepwater snapper/grouper fishery and overfishing is still occurring in the SAB (NMFS, 2006k). The Warsaw grouper is expected to occur within the range trunk cable corridor of all four sites.

3.2.8.2 Sea Turtles

As previously mentioned in Subchapter 3.2.5, all five sea turtle species found in the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs are listed as threatened or endangered.

- Loggerhead sea turtle (*Caretta caretta*) – threatened

- Green sea turtle (*Chelonia mydas*) – endangered (while green sea turtles are listed as threatened, the Florida and Mexican Pacific coast nesting populations are listed as endangered)
- Kemp's (Atlantic) Ridley sea turtle (*Lepidochelys kempi*) – endangered
- Hawksbill sea turtle (*Eretmochelys imbricata*) – endangered
- Leatherback sea turtle (*Dermochelys coriacea*) – endangered

3.2.8.3 Seabirds

The USFWS identifies two species of seabirds as endangered or threatened in some or all of the range areas:

- Bermuda petrel (*Pterodroma cahow*)
- Roseate tern (*Sterna dougallii*)

The Bermuda petrel is listed as endangered throughout its entire range in the U.S. (USFWS, 2006b). The Bermuda petrel was thought to be extinct for nearly 300 years until it was rediscovered in the first half of the twentieth century (National Geographic, 2001; BirdLife International, 2006d). It has been listed as endangered since 1970, primarily due to its small population size, which is estimated at 250 birds (USFWS, 2006c; IUCN, 2006). A record number of young (40) fledged in 2003 and another 35 fledged in 2005, indicating that the Bermuda petrel is slowly but steadily recovering (BirdLife International, 2006).

When not breeding in Bermuda, the Bermuda petrel may be distributed throughout the North Atlantic, but is primarily found in the warm waters of the Gulf Stream between Bermuda and North Carolina. In recent years, several confirmed sightings have occurred off of the coast of North Carolina, where the Gulf Stream separates from the U.S. coast and flows away from shore into the Atlantic (National Geographic, 2001; BirdLife International, 2006). With such a low worldwide population estimate (250 individuals) in addition to a distributional overlap with the black-capped petrel (*Pterodroma hasitata*), whose appearance is similar, it is difficult to identify the full range of the species (BirdLife International, 2006; NatureServe, 2006a).

Sightings of the Bermuda petrel occur off the North Carolina coast and in the Cherry Point, OPAREA and possibly the VACAPES OPAREA in late spring and summer; however, non-breeding adults and juveniles may also be present in this region at other times of the year (National Geographic, 2001; Avibase, 2003). Outside of the breeding season, Bermuda petrels are most likely to move north of Bermuda and follow the western/northern wall of the Gulf Stream while foraging, increasing the likelihood that individuals could occur in the VACAPES OPAREA (BirdLife International, 2006).

The northeastern breeding population of roseate terns is listed as endangered under the ESA. The range of this population extends along the U.S. Atlantic coast from Canada south to North Carolina (USFWS, 1993b, 2001c). Roseate terns in this population are known to occur in Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, North Carolina, and Virginia as well as in Newfoundland, Nova Scotia, and Quebec. Beyond the northeastern region, the roseate tern is listed as threatened in the western hemisphere and adjacent oceans, essentially wherever it is not listed as endangered. Threatened populations are known to occur in Florida, Georgia, North Carolina, South Carolina, Puerto Rico, and the USVI (NatureServe, 2006c). The global population is estimated to be 40,000 breeding pairs. The northeastern population has been fluctuating at around 3,500 pairs, recording a low of 3,125 pairs in 1992 and a high of 3,775 pairs in 1996 (BirdLife International, 2006; USFWS, 1993b). In 1993, the Caribbean population was estimated to be between 5,000 and 8,500 pairs, with 350 of those pairs breeding in the Florida Keys (USFWS, 1993b).

In the Atlantic, the northeastern breeding population is concentrated in isolated colonies mainly between Cape Cod, Massachusetts, and Long Island, New York. Smaller groups of breeding or wandering birds may be encountered farther south along the U.S. Atlantic coast and may be a mix of both the northeastern population and the Caribbean population (Sibley, 2000). Fifty percent of the northeastern population of roseate terns breeds within Buzzard's Bay, Massachusetts (Perkins et al., 2003). Additionally, a Caribbean population breeds in the Florida Keys, the Bahamas, the West Indies, and in other locations in central and northern South America. Non-breeding populations are found in and around the Bahamas, Cuba, and the Lesser Antilles (USFWS, 1993; NatureServe, 2006c). Based on this information, the roseate tern may occur at any of the four OPAREAs.

In addition, the Atlantic coastal population of least terns (*Sterna antillarum*) is not listed under the ESA but the interior U.S. population of least terns has been listed as endangered under the ESA since 1985 (USFWS, 1985). The least tern occurs regularly throughout all of the Atlantic OPAREAs during the breeding season of May through June. Least terns breed adjacent to all of the Atlantic OPAREAs from Maine south to Florida (NatureServe, 2006b). As the least tern population migrates to South America to overwinter (NatureServe, 2006b), they are not expected to be as common in the vicinity of the Atlantic OPAREAs during the non-breeding season, although stray individuals may be observed.

3.2.8.4 Mammals

Federally endangered marine mammals that may occur within the vicinity of the four proposed range locations are as follows:

- Fin whale, *Balaenoptera physalus*
- Humpback whale, *Megaptera novaeangliae*
- North Atlantic right whale, *Eubalaena glacialis*
- Sei whale, *Balaenoptera borealis*
- Blue whale, *Balaenoptera musculus*
- Sperm whale, *Physeter macrocephalus*
- West Indian manatee, *Trichechus manatus*

Subchapter 3.2.6 provided information on these marine mammal species, including the likelihood of the species' occurring in the proposed USWTR locations A, B, C, or D in the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs, respectively.

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3.3 Acoustical Environment

Within the oceans the only form of energy that travels efficiently is sound; for instance, radio and other electromagnetic waves are attenuated in water at a much greater degree than sound. The ability to use sound as an effective sensing medium in the ocean is dependent on the level of background noise (ambient noise) as it relates to the signal, or sound being received, and the physical factors of the ocean that affect the rate at which sound energy is lost.

This subchapter:

- Describes the phenomena and sources of sound within the marine environment (Subchapter 3.3.1).
- Discusses a screening process to define the marine animal species that need to be considered from an acoustical effect perspective (Subchapter 3.3.2).
- Provides an estimation of the density of those screened marine mammal species that will be considered from an acoustical effect perspective (Subchapter 3.3.3).

3.3.1 Sound in the Environment

Ambient sound in the environment comes from physical, biological, and anthropogenic sources. Table 3.3-1 provides example intensities (source level) of various underwater sound producers. Figure 3.3-1 illustrates the frequencies of each sound source.

3.3.1.1 Physical Sources of Sound

Physical processes that create sound in the ocean include rain, wind, waves, lightning striking the sea surface, undersea earthquakes, and eruptions from undersea volcanoes (Scowcroft et al., 2006). Generally, these sound sources contribute to a rise in the ambient sound levels on an intermittent basis. Rain produces sound in much the same manner as does wind; however, rain sound differs from wind sound in that its peak contribution to the field occurs at a slightly higher frequency, typically between 1 and 3 kilohertz (kHz). Even at moderate rain rates, the sound generated at these frequencies can easily exceed contributions from wind. For instance, the onset of rain raises high-frequency sound levels by 10 dB or more (U.S. Air Force, 2002).

Wind produces sound in frequencies between 0.1 and 30 kHz, while wave generated sound is a significant contributor in the infrasonic range (i.e., 0.001 to 0.020 kHz) (Simmonds et al., 2004). In addition, seismic activity results in the production of low-frequency sounds that can be heard for great distances (Discovery of Sound in the Sea [DOSITS], 2007). For example, in the Pacific Ocean, sounds from a volcanic eruption have been heard thousands of miles away (DOSITS, 2007).

Table 3.3-1

Source Levels of Common Underwater Sound Producers

Source	Source Level (decibels referenced to 1 micro Pascal at 1 meter)
Jet ski	75-125
Dolphin whistles	125-173
Humpback whale song	144-174
Blue whale	165
Snapping shrimp	183-189
Supertanker (340 meters long)	190
ATOC Acoustic Thermometry Source	195
Fishing vessel (12 meters long)	150
Earthquake	210
Mid-frequency Naval Sonar	235
Sperm whale click	236
Lightning strike	260
Notes: ATOC = Acoustic Thermometry of Ocean Climate Sources: Scowcroft et al., 2006; Inter-Agency Committee on Marine Science and Technology (IACMST), 2006; NOAA Pacific Marine Environmental Laboratory, 2007; and Simmonds et al., 2004	

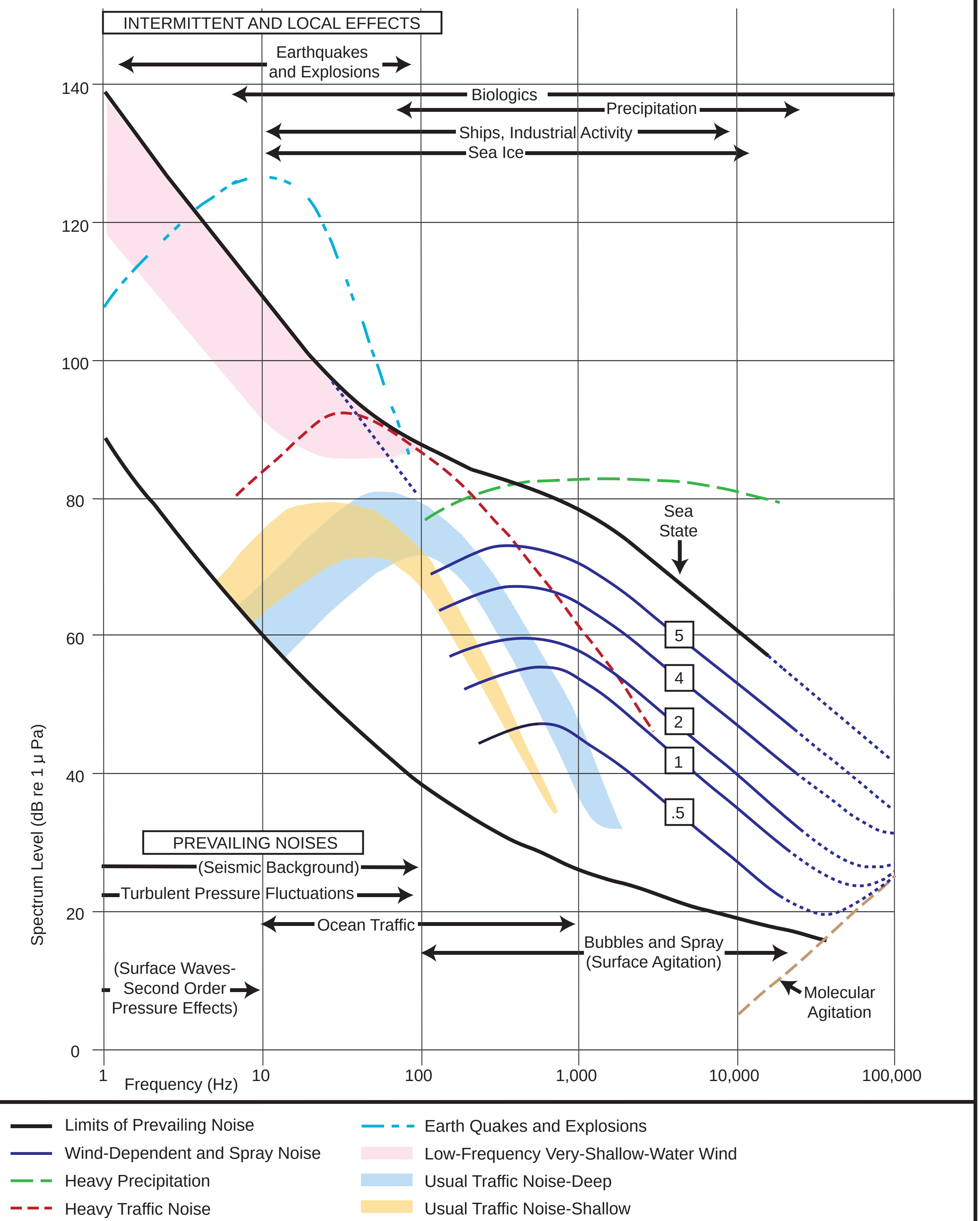
3.3.1.2 Biological Sources of Sound

Marine animals use sound to navigate, communicate, locate food, reproduce, and protect themselves underwater (Scowcroft et al., 2006). For example, reproductive activity, including courtship and spawning, accounts for the majority of sounds produced by fish. During the spawning season, croakers vocalize for many hours and often dominate the acoustic environment (Scowcroft et al., 2006). In addition, toothed whales and dolphins (odontocetes) produce a wide variety of sounds including clicks, whistles, and pulsed sounds. Marine life of various types can raise sound levels near 20 dB (e.g., dolphin whistles), in the range of a few kHz (e.g., crustaceans and fish), and in the tens to hundreds of kHz (e.g., dolphin clicks). For instance, bottlenose dolphin clicks and whistles have a dominant frequency range of 110 to 130 kHz and 3.5 to 14.5 kHz, respectively (Au, 1993; Ketten, 1998). In addition, sperm whale clicks range in frequency from 0.1 kHz to 30 kHz, with dominant energy in two bands (2 to 4 kHz and 10 to 16 kHz) (Thomson and Richardson, 1995). Figure 3.3-1 illustrates the variability from all of these potential sound sources.

3.3.1.3 Anthropogenic Sources of Sound

Anthropogenic (man-made) sound is introduced into the ocean by a number of sources, including vessel traffic, industrial operations onshore (pile driving), seismic profiling for oil exploration, oil drilling, and sonar operation for scientific research. In open oceans, the primary persistent anthropogenic sound source tends to be commercial shipping, since over 90 percent of global

Ambient Sound Levels



Source: adapted from Wenz, 1962.

Figure 3.3-1

trade depends on transport across the seas (Scowcroft et al., 2006). Specifically, 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 United States has increased 2.45 percent each year over a 20 year period (1981 to 2001) (Southall, 2005). International shipping volumes and densities are expected to continually increase in the foreseeable future (Southall, 2005). The increase in shipping volumes and densities will most likely increase overall ambient noise levels in the ocean. However, it is not known whether these increases would have an effect on marine mammals (Southall, 2005).

High intensity, low frequency impulsive sounds are emitted during seismic surveys to determine the structure and composition of the geological formations below the sea bed in order to identify potential hydrocarbon reservoirs (i.e., oil and gas exploration) (Simmonds et al., 2004). One type of sound source is airguns. These devices rapidly release compressed air with source levels between 215 and 230 dB with a reference pressure of 1 micro Pascal (dB re 1 μPa), and the highest energies falling in the range of 0.01 to 0.3 kHz, into the water. Airgun shots are fired at 6 to 20 second (sec) intervals along transect lines at speeds ranging from 2 to 3 m/s (4 to 6 kt) at a depth of 4 to 10 m (13 to 33 ft) (Simmonds et al., 2004).

Commercial vessels have the highest sound levels at lower frequencies. Since sound propagation is most favorable at lower frequencies, particularly in deep water, surface ships can often be heard at distances greater than 100 km (54 NM). Thus, at many deep-water locations, it is not unusual for a low-frequency sound to be influenced by contributions from tens or even hundreds of surface ships (U.S. Air Force, 2002).

3.3.2 Acoustic Screening of Marine Species

As sound travels through water, it causes oscillatory motion of the water molecules and perturbations in the pressure. The number of complete oscillatory cycles that occur within one second of time is called the frequency, which has units of cycles per second (or hertz [Hz]). Navy sound sources are categorized as low, mid-, or high frequency:

- Low frequency – Below 1 kHz
- Mid-frequency – From 1 to 10 kHz (proposed USWTR operations would include mid-frequency sound sources)
- High frequency – Above 10 kHz (proposed USWTR operations include high frequency sound sources)

Animals hear at many different frequencies, which can vary not only between species but also from individual to individual. From an acoustical impact perspective, for a marine animal to be affected by the mid- and high frequency sound sources operating on the USWTR, it must:

- Be within the geographic area influenced by the active acoustics on one of the four potential USWTR sites.
- Possess structures that mechanically respond to sound energy produced by sources operating within the USWTR sites.

Species that did not meet these criteria were excluded from further consideration of acoustic effects in this OEIS/EIS.

With respect to the first criterion, Subchapter 3.2 presents a discussion of those marine animals that could be present at the four potential USWTR sites. Pinnipeds (seals and sea lions), for example, were addressed and ruled out from further analysis because they would not be present at the sites and, thus, are not of concern from an acoustical effect perspective.

With respect to the second criterion, in order for sound to have an effect on an animal, some organ or tissue must be capable of mechanically responding to the oscillatory sound wave. This means that the animal must possess mechanical structures that respond to the mid- and high frequencies generated by sources within the USWTR. Although most aquatic animals possess structures that respond to low frequency hydrodynamic motion (gross water motion), fewer animals possess structures that respond to mid- and high frequencies, where the influence of sound particle motion is diminished and sound pressure dominates. To mechanically respond to mid- and high frequency sound pressure, an animal must possess tissues that not only respond to those frequencies but also have an acoustic impedance different from water (an impedance mismatch). Thus, many organisms would be unaffected, even if they were in areas with high mid-frequency sound levels, because they do not have significant acoustic impedance mismatches or cannot detect mid-frequency sounds.

These factors immediately limit the types of organisms that could be adversely exposed to mid- and high frequency sound levels. For example, phytoplankton and zooplankton species have no sufficient impedance mismatches or tissues to respond mid- and high frequencies (the sound pulse would essentially pass through them without being detected). Therefore, phytoplankton and zooplankton do not have the potential to be physically affected by the operation of mid-frequency sound sources on the USWTR, and thus are not evaluated further in this OEIS/EIS.

In contrast, all vertebrates have specialized organs for hearing. Vertebrates, especially those species whose bodies contain air-filled cavities (e.g., lungs, sinuses), offer a high impedance contrast with water, and hence are potentially susceptible to mid- and high frequency sound sources on the USWTR.

In the case of species for which direct evidence of acoustic sensitivity is lacking, reasonable indirect evidence was used to support the evaluation (e.g., there is no direct evidence that a species hears mid-frequency sound but good evidence that the species produces mid-frequency sound). In cases where important biological information was not available or was insufficient for one species, but data were available for a related species, the comparable data were used. Particular attention was given to species with either special protected-population status or limited potential for reproductive replacement in the event of mortality.

3.3.2.1 Plankton and Benthic Invertebrates

Plankton has been categorically eliminated from further consideration in this OEIS/EIS because:

- They do not have delicate organs or tissues whose acoustic impedance is significantly different from water or that can respond to mid- and high frequency sound waves.

- There is no evidence of auditory capabilities in the frequency range to be used on the USWTR.

While some gelatinous plankton have air-filled bladders, they would not be affected by sources operating on the USWTR because of their extremely small size relative to the sound wavelengths.

Very little is known about sound detection and use of sound by invertebrates (Budelmann, 1992a, b; Popper et al., 2001). The limited data show that some crabs are able to detect sound, and there has been the suggestion that some other groups of invertebrates are also able to detect sounds. In addition, cephalopods (octopus and squid) and decapods (lobster, shrimp, and crab) are thought to sense low frequency sound (Budelmann, 1992b). Lovell et al. (2005) determined that prawns can hear between 100 and 3,000 Hz, with best hearing capabilities at 100 Hz. Packard et al. (1990) reported sensitivity to sound vibrations between 1-100 Hz for three species of cephalopods. Wilson et al. (2007) documents a lack of physical or behavioral response for squid exposed to experiments using high intensity sounds designed to mimic killer whale echolocation signals. In contrast, McCauley et al. (2000) reported that caged squid exhibit behavioral responses when exposed to impulsive sounds from a seismic airgun.

There has also been the suggestion that invertebrates do not detect pressure since few, if any, have air cavities that would function like the fish swim bladder in responding to pressure. It is important to note that some invertebrates, and particularly cephalopods, have specialized end organs, called statocysts, for determination of body and head motions that are similar in many ways to the otolithic end organs of fish. The similarity includes these invertebrates having sensory cells which have some morphological and physiological similarities to the vertebrate sensory hair cell, and the "hairs" from the invertebrate sensory cells are in contact with a structure that may bear some resemblance to vertebrate otolithic material (Budelmann, 1992a, b).

As a consequence of having statocysts, it is possible that these species could be sensitive to particle motion (Popper et al., 2001).

It is also important to note that invertebrates may have other organs that potentially detect the particle motion of sound, the best known of which are special water motion receptors known as chordotonal organs (e.g., Budelmann, 1992a). These organs facilitate the detection of potential predators and prey and provide environmental information such as the movement of tides and currents. In fact, fiddler crab (*Uca* sp.) and spiny lobster (*Panulirus* sp.) have both been shown to use chordotonal organs to respond to nearby predators and prey.

Given that the mid- and high frequency sounds of USWTR sources are not considered to be in the primary detection range of those invertebrate species that may possess the ability to detect sound, the potential for effects is negligible for invertebrate species that may inhabit the area during USWTR operations. Invertebrates, therefore, are not addressed further from an acoustical perspective in this OEIS/EIS.

3.3.2.2 Fish

Marine fish spend at least part of their life in salt water. All fish have two sensory systems that are used to detect sound in the water including the inner ear, which functions very much like the inner ear found in other vertebrates, and the lateral line, which consists of a series of receptors along the body of the fish (DoN, 2008p). The inner ear generally detects higher frequency sounds while the lateral line detects water motion at low frequencies (below a few hundred Hz) (Hastings and Popper, 2005). A sound source produces both a pressure wave and motion of the medium particles (water molecules in this case), both of which may be important to fish. Fish detect particle motion with the inner ear. Pressure signals are initially detected by the gas-filled swim bladder or other air pockets in the body, which then re-radiate the signal to the inner ear (DoN, 2008p). Because particle motion attenuates relatively quickly, the pressure component of sound usually dominates as distance from the source increases. A more detailed discussion of the lateral line can be found at the end of this section. Broadly, fishes can be categorized as either hearing specialists or hearing generalists (DoN, 2008p). Fishes in the hearing specialist category have a broad frequency range with a low auditory threshold due to a mechanical connection between an air filled cavity, such as a swimbladder, and the inner ear. Specialists detect both the particle motion and pressure components of sound and can hear at levels above 1 kHz. Generalists are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (DoN, 2008p). It is possible that a species will exhibit characteristics of generalists and specialists and will sometimes be referred to as an "intermediate" hearing specialist. For example, most damselfish are typically categorized as generalists, but because some larger damselfish have demonstrated the ability to hear higher frequencies expected of specialists, they are sometimes categorized as intermediate.

Although hearing capability data only exists for fewer than 100 of the 29,000 fish species (DoN, 2008p), current data suggest that most species of fish detect sounds from 0.05 to 1.0 kHz, with few fish hearing sounds above 4 kHz (DoN, 2008p; NRC, 2003). Moreover, studies indicate that hearing specializations in marine species are quite rare and that most marine fish are considered hearing generalists (Popper, 2003; Amoser and Ladich, 2005). Specifically, the following species are all believed to be hearing generalists: elasmobranchs (i.e., sharks and rays) (Casper et al., 2003; Casper and Mann, 2006; Myrberg, 2001), scorpaeniforms (i.e., scorpionfishes, searobins, sculpins) (Lovell et al., 2005), scombrids (i.e., albacores, bonitos, mackerels, tunas) (Iversen, 1967, 1969; Popper, 1981; Song et al., 2006), damselfishes (Egner and Mann, 2005; Kenyon, 1996; Wright et al., 2005, 2007), and more specifically, midshipman fish (*Porichthys notatus*) (Sisneros and Bass, 2003), Atlantic salmon (*Salmo salar*) (Hawkins and Johnstone, 1978), and Gulf toadfish (*Opsanus beta*) (Remage-Healey et al., 2006). Moreover, it is believed that the majority of marine fish have their best hearing sensitivity at or below 0.3 kHz (Popper, 2003). However, it has been demonstrated that marine hearing specialists, such as some Clupeidae, can detect sounds above 100 kHz. Table 3.3-2 provides a list of marine fish hearing sensitivities.

In contrast to marine fish, several thousand freshwater species are thought to be hearing specialists. Nelson (1994) estimates that 6,600 of 10,000 freshwater species are otophysans (catfish and minnows), which are hearing specialists. Interestingly, many generalist freshwater species, such as perciforms (percids, gobiids) and scorpaeniforms (sculpins) are thought to have derived from marine habitats (Amoser and Ladich, 2005). It is also thought that Clupeidae may have evolved from freshwater habitats (Popper et al., 2004). This supports the theory that hearing specializations likely evolved in quiet habitats common to freshwater and the deep sea because only in such habitats can hearing specialists use their excellent hearing abilities (Amoser and Ladich, 2005).

Some investigators (e.g., Amoser and Ladich, 2005) hypothesized that, within a family of fish, different species can live under different ambient noise conditions, which requires them to adapt their hearing abilities. Under this scenario, a species' probability of survival would be greater if it increased, the range over which the acoustic environment, consisting of various biotic (sounds from other aquatic animals) and abiotic (wind, waves, precipitation) sources, can be detected (Amoser and Ladich, 2005). In the marine environment, Amoser and Ladich (2005) cite the differences in the hearing ability of two species of Holocentridae as a possible example of such environmentally-derived specialization. Both the shoulderbar soldierfish (*Myripristis kuntee*) and the Hawaiian squirrelfish (*Adioryx xantherythrus*) can detect sounds at 0.1 kHz. However, the high frequency end of the auditory range extends towards 3 kHz for the shoulderbar soldierfish but only to 0.8 kHz for the Hawaiian squirrelfish (Coombs and Popper, 1979). However, as these two species live in close proximity on the same reefs, it is not certain that differing environmental conditions cause the hearing variations (DoN, 2008p). Generally, a clear correlation between hearing capability and the environment cannot be asserted or refuted due to limited knowledge of ambient noise levels in marine habitats and a lack of comparative studies.

Table 3.3-2

Marine Fish Hearing Sensitivities

Family	Description of Family	Common Name	Scientific Name	Hearing Range (kHz)		Greatest Sensitivity (kHz)	Sensitivity Classification
				Low	High		
Albulidae	Bonefishes	Bonefish	*Albula vulpes*	0.1	0.7	0.3	generalist
Anguillidae	Eels	European eel	*Anguilla anguilla*	0.01	0.3	0.04-0.1	generalist
Ariidae	Catfish	Hardhead sea catfish	*Ariopsis* (*Arius*) *felis**	0.05	1	0.1	generalist
Batrachoididae	Toadfishes	Midshipman	*Porichthys notatus*	.065	0.385		generalist
		Gulf toadfish	*Opsanus beta*			<1	generalist
Clupeidae	Herrings, shads, menhadens, sardines	Alewife	*Alosa psuedoharengus*		0.12		specialist
		Blueback herring	*Alosa aestivalis*		0.12		specialist
		American shad	*Alosa sapidissima*	0.1	0.18	0.2-0.8 and 0.025-0.15	specialist
		Gulf menhaden	*Brevoortia patronus*		0.1		specialist
		Bay anchovy	*Anchoa mitchilli*		4		specialist
		Scaled sardine	*Harengula jaguana*		4		specialist
		Spanish sardine	*Sardinella aurita*		4		specialist
		Pacific herring	*Clupea pallasii*	0.1	5		specialist
Chondrichthyes [Class]	Cartilaginous fishes, rays, sharks, skates			0.2	1		generalist
Gadidae	Cods, gadiforms, grenadiers, hakes	Cod	*Gadus morhua*	0.002	0.5	0.02	generalist
Gobidae	Gobies	Black goby	*Gobius niger*	0.1	0.8		generalist
Holocentridae	Squirrelfish and soldierfish	Shoulderbar soldierfish	*Myripristis kuntee*	0.1	3.0	0.4-0.5	specialist
		Hawaiian squirrelfish	*Adioryx xantherythrus*	0.1	0.8		generalist
Labridae	Wrasses	Tautog	*Tautoga onitis*	0.01	0.5	0.037-0.050	generalist
		Blue-head wrasse	*Thalassoma bifasciatum*	0.1	1.3	0.3-0.6	generalist
Lutjanidae	Snappers	Schoolmaster snapper	*Lutjanus apodus*	0.1	1.0	0.3	generalist
Myctophidae	Lanternfishes	Warming's lanternfish	*Ceratoscopelus warmingii*				specialist
Pleuronectidae	Flatfish	Dab	*Limanda limanda*	0.03	0.27	0.1	generalist
		European plaice	*Pleuroncetes platessa*	0.03	0.2	0.11	generalist
Pomadasyidae	Grunts	Blue striped grunts	*Haemulon sciurus*	0.1	1.0		generalist

Table 3.3-2 (cont'd)

Marine Fish Hearing Sensitivities

Family	Description of Family	Common Name	Scientific Name	Hearing Range (kHz)		Greatest Sensitivity (kHz)	Sensitivity Classification
				Low	High		
Pomacentridae	Damselfish	Sergeant major damselfish	*Abudefduf saxatilis*	0.1	1.6	0.1-0.4	Generalist/ intermediate
		Bicolor damselfish	*Stegastes partitus*	0.1	1.0	0.5	Generalist/ intermediate
		Nagasaki damselfish	*Pomacentrus nagasakiensis*	0.1	2.0	<0.3	Generalist/ intermediate
Salmonidae	Salmons	Atlantic salmon	*Salmo salar*	<0.1	0.58		generalist
Sciaenidae	Drums, weakfish, croakers	Atlantic croaker	*Micropogonias undulates*	0.1	1.0	0.3	generalist
		Spotted sea trout	*Cynoscion nebulosus*				generalist
		Kingfish	*Menticirrhus americanus*				generalist
		Spot	*Leiostomus xanthurus*	0.2	0.7	0.4	generalist
		Black drum	*Pogonias cromis*	0.1	0.8	0.1-0.5	generalist
		Weakfish	*Cynoscion regalis*	0.2	2.0	0.5	specialist
		Silver perch	*Bairdiella chrysoura*	0.1	4.0	0.6-0.8	specialist
Scombridae	Albacores, bonitos, mackerels, tunas	Bluefin tuna	*Thunnus thynnus*		1.0		generalist
		Yellowfin tuna	*Thunnus albacares*	0.5	1.1		Generalist
		Kawakawa	*Euthynnus affinus*	0.1	1.1	0.5	generalist
		Skipjack tuna	*Katsuwonus pelamis*				generalist
Scorpaenidae	Scorpionfishes, searobins, sculpins	Sea scorpion	*Taurulus bubalis*				generalist
Serranidae	Seabasses, groupers	Red hind	*Epinephelus guttatus*	0.1	1.1	0.2	generalist
Sparidae	Porgies	Pinfish	*Lagodon rhomboides*	0.1	1.0	0.3	generalist
Triglidae	Scorpionfish, searobins, sculpins	Leopard searobin	*Prionotus scitulus*	0.1	0.8	0.39	generalist

Notes: * Referenced as *Arius felis* by Popper and Tavolga, 1981

Sources: Astrup, 1999; Astrup and Møhl, 1993; Casper and Mann, 2006; Casper et al., 2003; Coombs and Popper, 1979; Dunning et al., 1992; Egner and Mann, 2005; Gregory and Clabburn, 2003; Hawkins and Johnstone, 1978; Higgs et al., 2004; Iversen, 1967, 1969; Jorgensen et al., 2004; Kenyon, 1996; Lovell et al., 2005; Mann et al., 1997, 2001, 2005; Myrberg, 2001; Nestler et al., 2002; Popper, 1981; Popper and Carlson, 1998; Popper and Tavolga, 1981; Ramcharitar and Popper, 2004; Ramcharitar et al., 2001, 2004, 2006, Remage-Healey, et al., 2006; Ross et al., 1996; Sisneros and Bass, 2003; Song et al., 2006; Wright et al., 2005, 2007; Seaworld, 2007; DoN, 2008p.

It has also been shown that susceptibility to the effects of anthropogenic sound can be influenced by developmental and genetic differences in the same species of fish. In an exposure experiment, Popper et al. (2007) found that experimental groups of rainbow trout (*Oncorhynchus mykiss*) had substantial differences in hearing thresholds. While fish were attained from the same supplier, it is possible different husbandry techniques may be reason for the differences in hearing sensitivity. These results emphasize that caution should be used in extrapolating data beyond their intent.

Among all fishes studied to date, perhaps the greatest variability is found within the family Sciaenidae (i.e., drumfish, weakfish, croaker), where there is extensive diversity in inner ear structure and the relationship between the swim bladder and the inner ear. Specifically, the Atlantic croaker's (*Micropogonias undulatus*) swim bladder has forwardly directed diverticulae that come near the ear but do not actually touch it. However, the swim bladders in the spot (*Leiostomus xanthurus*) and black drum (*Pogonias cromis*) are further from the ear and lack anterior horns or diverticulae. These differences are associated with variation in both sound production and hearing capabilities (Ladich and Popper, 2004; Ramcharitar et al., 2006b). Ramcharitar and Popper (2004) discovered that the black drum responded to sounds from 0.1 to 0.8 kHz and was most sensitive between 0.1 and 0.5 kHz, while the Atlantic croaker responded to sounds from 0.1 to 1 kHz and was most sensitive at 0.3 kHz. Additional sciaenid research by Ramcharitar et al. (2006) investigated the hearing sensitivity of weakfish (*Cynoscion regalis*) and spot. Weakfish were found to detect frequencies up to 2 kHz, while spot detected frequencies only up to 0.7 kHz.

The sciaenid with the greatest hearing sensitivity discovered thus far is the silver perch (*Bairdiella chrysoura*), which has demonstrated auditory thresholds similar to goldfish, responding to sounds up to 4 kHz (Ramcharitar et al., 2004). Silver perch swim bladders have anterior horns that terminate close to the ear. The Ramcharitar et al. (2004) research supports the suggestion that the swim bladder can potentially expand the frequency range of sound detection. Furthermore, Sprague and Luczkovich (2004) calculated silver perch are capable of producing drumming sounds ranging from 128 to 135 dB. Since drumming sounds are produced by males during courtship, it can be inferred that silver perch detect sounds within this range.

The most widely noted hearing specialists are otophysans, which have bony Weberian ossicles, (bones that connect the swim bladder to the ear), along which vibrations are transmitted from the swim bladder to the inner ear (Amoser and Ladich, 2003; Ladich and Wysocki, 2003). However, only a few otophysans inhabit marine waters. In an investigation of a marine otophysan, the hardhead sea catfish (*Ariopsis felis*), Popper and Tavolga (1981) determined that this species was able to detect sounds from 0.05 to 1 kHz, which is considered a much lower and narrower frequency range than that common to freshwater otophysans (i.e., above 3 kHz) (Ladich and Bass, 2003). The difference in hearing capabilities in the respective freshwater and marine catfish appears to be related to the inner ear structure (Popper and Tavolga, 1981).

Experiments on marine fish have obtained responses to frequencies up to the range of ultrasound; that is, sounds between 40 to 180 kHz (University of South Florida, 2007). These responses were from several species of the Clupeidae (i.e., herrings, shads, and menhadens) (Astrup, 1999); however, not all clupeid species tested have responded to ultrasound. Astrup (1999) and Mann et al. (1998) hypothesized that these ultrasound detecting species may have developed such high sensitivities to avoid predation by odontocetes. Studies conducted on the following species showed avoidance to sound at frequencies over 100 kHz: alewife (*Alosa pseudoharengus*) (Dunning et al., 1992; Ross et al., 1996), blueback herring (*A. aestivalis*) (Nestler et al., 2002), Gulf menhaden (*Brevoortia patronus*) (Mann et al., 2001) and American shad (*A. sapidissima*) (Popper and Carlson, 1998). The highest frequency to solicit a response in any marine fish was 180 kHz for the American shad (Gregory and Clabburn, 2003; Higgs et al., 2004). The *Alosa* species have relatively low thresholds (about 145 dB re 1 µPa), which should enable the fish to detect odontocete clicks at distances up to about 200 m (656 ft) (Mann et al., 1997). For example, echolocation clicks ranging from 200 to 220 dB could be detected by shad with a hearing threshold of 170 dB at distances from 25 to 180 m (82 to 591 ft) (University of South Florida, 2007). In contrast, the Clupeidae bay anchovy (*Anchoa mitchilli*), scaled sardine (*Harengula jaguana*), and Spanish sardine (*Sardinella aurita*) did not respond to frequencies over 4 kHz (Gregory and Clabburn, 2003; Mann et al., 2001).

Wilson and Dill (2002) demonstrated that there was a behavioral response seen in Pacific herring (*Clupea pallasii*) to energy levels associated with frequencies from 1.3 to 140 kHz, although it was not clear whether the herring were responding to the lower-frequency components of the experiment or to the ultrasound. However, Mann et al. (2005) advised that acoustic signals used in the Wilson and Dill (2002) study were broadband and contained energy of less than 4 kHz to ultrasonic frequencies. Contrary to the Wilson and Dill (2002) conclusions, Mann et al. (2005) found that Pacific herring could not detect ultrasonic signals at received levels up to 185 dB re 1 µPa. Pacific herring had hearing thresholds (0.1 to 5 kHz) that are typical of Clupeidae that do not detect ultrasound signals.

Species that can detect ultrasound do not perceive sound equally well at all detectable frequencies. Mann et al. (1998) reported that the American shad can detect sounds from 0.1 to 180 kHz with two regions of best sensitivity: one from 0.2 to 0.8 kHz, and the other from 25 to 150 kHz. The poorest sensitivity was found from 3.2 to 12.5 kHz.

Although few non-clupeid species have been tested for ultrasound (Mann et al., 2001), the only other non-clupeid species shown to possibly be able to detect ultrasound is the cod (*Gadus morhua*) (Astrup and Møhl, 1993). However, in Astrup and Møhl's (1993) study it is feasible that the cod was detecting the stimulus using touch receptors that were over driven by very intense fish-finding sonar emissions (Astrup, 1999; Ladich and Popper, 2004). Nevertheless, Astrup and Møhl (1993) indicated that cod have ultrasound thresholds of up to 38 kHz at 185 to 200 dB re 1 µPa, which likely only allows for detection of odontocete's clicks at distances no greater than 10 to 30 m (33 to 98 ft) (Astrup, 1999).

As mentioned above, investigations into the hearing ability of marine fishes have most often yielded results exhibiting poor hearing sensitivity. Experiments on elasmobranch fish (i.e., sharks and rays) have demonstrated poor hearing abilities and frequency sensitivity from 0.02 to

1 kHz, with best sensitivity at lower ranges (Casper et al., 2003; Casper and Mann, 2006; Myrberg, 2001). Though only five elasmobranch species have been tested for hearing thresholds, it is believed that all elasmobranchs will only detect low frequency sounds because they lack a swim bladder, which resonates sound to the inner ear. Theoretically, fishes without an air-filled cavity are limited to detecting particle motion and not pressure and therefore have poor hearing abilities (Casper and Mann, 2006).

By examining the morphology of the inner ear of bluefin tuna (*Thunnus thynnus*), Song et al. (2006) hypothesized that bluefin tuna probably do not detect sounds to much over 1 kHz (if that high). This research concurred with the few other studies conducted on tuna species. Iversen (1967) found that yellowfin tuna (*T. albacares*) can detect sounds from 0.05 to 1.1 kHz, with best sensitivity of 89 dB (re 1 µPa) at 0.5 kHz. Kawakawa (*Euthynnus affinus*) appear to be able to detect sounds from 0.1 to 1.1 kHz but with best sensitivity of 107 dB (re 1 µPa) at 0.5 kHz (Iversen, 1969). Additionally, Popper (1981) looked at the inner ear structure of a skipjack tuna (*Katsuwonus pelamis*) and found it to be typical of a hearing generalist. While only a few species of tuna have been studied, and in a number of fish groups both generalists and specialists exist, it is reasonable to suggest that unless bluefin tuna are exposed to very high intensity sounds from which they cannot swim away, short- and long-term effects may be minimal or nonexistent (Song et al., 2006).

Some damselfish have been shown to be able to hear frequencies of up to 2 kHz, with best sensitivity well below 1 kHz. Egner and Mann (2005) found that juvenile sergeant major damselfish (*Abudefduf saxatilis*) were most sensitive to lower frequencies (0.1 to 0.4 kHz); however, larger fish (greater than 50 millimeters) responded to sounds up to 1.6 kHz. Still, the sergeant major damselfish is considered to have poor sensitivity in comparison even to other hearing generalists (Egner and Mann, 2005). Kenyon (1996) studied another marine generalist, the bicolor damselfish (*Stegastes partitus*), and found the bicolor damselfish responded to sounds up to 1.6 kHz with the most sensitive frequency at 0.5 kHz. Further, larval and juvenile Nagasaki damselfish (*Pomacentrus nagasakiensis*) have been found to hear at frequencies between 0.1 and 2 kHz, however, they are most sensitive to frequencies less than 0.3 kHz (Wright et al., 2005, 2007). Thus, damselfish appear to be primarily generalists with some ability to hear slightly higher frequencies expected of specialists (DoN, 2008p).

Female midshipman fish apparently use the auditory sense to detect and locate vocalizing males during the breeding season. Interestingly, female midshipman fish go through a shift in hearing sensitivity depending on their reproductive status. Reproductive females showed temporal encoding up to 0.34 kHz, while nonreproductive females showed comparable encoding only up to 0.1 kHz (Sisneros and Bass, 2003).

The hearing capability of Atlantic salmon indicates a rather low sensitivity to sound (Hawkins and Johnstone, 1978). Laboratory experiments yielded responses only to 0.58 kHz and only at high sound levels. Salmon’s poor hearing is likely due to the lack of a link between the swim bladder and inner ear (Jorgensen et al., 2004).

Furthermore, investigations into the inner ear structure of fishes belonging to the order Scorpaeniformes have suggested that these fishes have generalist hearing abilities (Lovell et al., 2005). Although an audiogram (which provides a measure of hearing sensitivity) has yet to be performed, the lack of a swimbladder is indicative of these species having poor hearing ability (Lovell et al., 2005). However, studies of the leopard robin (*Prionotus scitulus*), another species in this order that do contain swim bladders, indicated that they are hearing generalists as well (Tavolga and Wodinski, 1963) which makes extrapolation on hearing from this species to all members of the group very difficult to do (DoN, 2008p).

As mentioned above, the lateral line is the second component of the sensory system used by fish to detect acoustic signals. The lateral line system of a fish allows for sensitivity to sound (Hastings and Popper, 2005). This system is a series of receptors along the body of the fish that detects water motion relative to the fish that arise from sources within a few body lengths of the animal. The sensitivity of the lateral line system is generally from below 1 Hz to a few hundred Hz (Coombs and Montgomery, 1999; Webb et al., 2008). The only study on the effect of exposure to sound on the lateral line system (conducted on one freshwater species) suggests no effect on these sensory cells by intense pure tone signals (Hastings et al., 1996). While studies on the effect of sound on the lateral line are limited, work by Hasting et al. (1996) showed limited sensitivity to within a few body lengths and to sounds below a few hundred Hertz, indicating that the mid-frequency sonar of the Proposed Action is unlikely to affect a fish's lateral line system. Therefore, further discussion of the lateral line in this analysis is unwarranted.

Of the fish species with distributions overlapping the USTWR sites for which hearing sensitivities are known, most are hearing generalists. Because the majority of fish species can detect sounds to 1 kHz or below, which is below the level of projected sound sources on USWTR, the potential for fish to experience direct effects from USWTR operations involving sound would be minor.

3.3.2.3 Sea Turtles

Five species of sea turtles could potentially occur within the proposed USWTR sites, as described in Subchapter 3.2. The Florida and Mexican Pacific coast nesting populations of the green sea turtle are listed as endangered; all other green sea turtles are listed as threatened. The hawksbill, Kemp's ridley, and leatherback turtles are also listed as endangered species. The loggerhead turtle is listed as a threatened species under the ESA. The few studies completed on the auditory capabilities of sea turtles suggest that they could be capable of hearing low frequency, but not mid-frequency, sounds.

Sea turtle hearing sensitivity, in air and water, is not well studied. Reception of sound is through bone conduction, with the skull and shell acting as receiving structures (Lenhardt et al., 1983). Typically, sea turtles hear frequencies from 30 to 2,000 Hz and have a range of maximum sensitivity between 100 to 800 Hz (Ridgway et al., 1969; Lenhardt, 1994). Green turtles can hear sounds ranging from 60 to 1,000 Hz and are most sensitive to airborne sounds ranging from 300 to 400 Hz (Ridgway et al., 1969). Bartol et al. (1999) reported that juvenile loggerhead turtles hear sounds between 250 (lowest frequency that could be tested due to equipment) and 1,000 Hz (most sensitive at 250 Hz) using the auditory brainstem response (ABR) technique, while (Lenhardt, 2002) found that adults can hear sounds from 30 Hz to 1,000 Hz (most sensitive at 400 to 500 Hz) using startle response (i.e., contract neck or dive) and ABR techniques. Bartol and Ketten (2006) found that six subadult green sea turtles from Hawaii detected frequencies between 100 to 500 Hz with the most sensitive hearing between 200 to 400 Hz using the ABR technique. Two juvenile green turtles they tested in Maryland had a slightly expanded range of hearing, with responses to sounds ranging from 100 to 800 Hz and the most sensitive hearing range from 600 to 700 Hz, while two juvenile Kemp's ridleys had a hearing range of 100 to 500 Hz, with the most sensitive hearing falling between 100 to 200 Hz (Bartol and Ketten, 2006).

There is limited auditory data available for the leatherback turtle. Eckert et al. (1998) attempted to collect hearing sensitivity data on nesting leatherbacks during egg-laying using auditory-evoked potentials. Generally, if a detectable auditory-evoked potential (AEP) is found, the subject animal can hear the test stimuli. However, if no AEP is detected, the response may simply lack sufficient signal level to be detected above considerable electrophysiological and electrical ambient noise. Eckert et al. (1998) were unable to collect data that conformed to the criteria for an auditory brainstem response in leatherbacks due to cross-talk between the projecting system (headphones, output amplifier) and receiving system (electrode, input amplifier). Cook and Forrest (2005) demonstrated nesting leatherbacks can produce sounds as high as 1,200 Hz while nesting, but they could not determine whether these sounds were associated solely with respiration or were also communicative in nature. Communicative sounds must fall within the audible range of the species. The authors noted that peak frequencies of the sounds they recorded from nesting leatherbacks were between 300 to 500 Hz, consistent with the low-frequency hearing range found in other turtle species discussed above.

Adult loggerheads have also been observed to initially respond (i.e., increase swimming speeds) and avoid air guns when received sound levels range from 151 to 175 dB re 1 μPa, but they eventually habituate to these sounds (Lenhardt, 2002). One turtle being studied did exhibit temporary threshold shift (TTS) for up to two weeks after exposure to these levels (Lenhardt, 2002). Juveniles also have been found to avoid low frequency sound (less than 1,000 Hz) produced by airguns (O'Hara and Wilcox, 1990). McCauley et al. (2000) found that green and loggerhead sea turtles exposed to seismic air guns began to noticeably increase their swimming speed, as well swimming direction, when received levels reached 155 dB re 1 μPa^2s for green turtles and 166 dB re 1 μPa^2s for loggerhead turtles. Though auditory data has never been collected for the leatherback turtle, there is an anecdotal observation of this species responding to the sound of a boat motor (USARPA and NMFS, 1995b). It is unclear what frequencies of the sound this species was detecting. In terms of sound production, nesting leatherback turtles have been recorded producing sounds (sighs or belch-like sounds) up to 1,200 Hz with most energy ranging from 300 to 500 Hz (Mrosovsky, 1972; Cook and Forrest, 2005).

Because the best hearing range for sea turtles is most likely less than 1 kHz, below the level of projected sound sources on the USWTR, the potential for sea turtles to experience direct acoustic effects from USWTR operations is negligible. Thus, sea turtles are not addressed further, from a direct acoustic effects perspective, in this OEIS/EIS.

3.3.2.4 Marine Mammals

Several groups of marine mammals can be found in the four proposed USWTR sites. The most numerous of them are delphinid whales (dolphins), followed by other toothed whales, baleen whales, and porpoises. Pinniped species are not likely to occur at the proposed USWTR sites; therefore, they are excluded from further evaluation.

Manatees can be found in the Gulf of Mexico and Atlantic coastal waters of the southeastern U.S. north to North Carolina. Manatees have the capability of hearing active sonar mid-frequency and high frequency sonar. Because manatees inhabit bays, rivers, lakes, and coastal waters, they would lie outside of the operating range of the USWTR (i.e., operational requirements for the USWTR require a depth of 37 to 274 m [120 to 900 ft]). Although manatees would not be present on the USWTR sites, they could be in coastal ocean waters (very close to shore).

Mysticete whales produce low frequency sounds that may be used as contact calls, for mating displays, for maintaining the cohesion of the migratory herd, and possibly for navigation and food-finding. Although there are no direct data on auditory thresholds for any mysticete species, anatomical evidence strongly suggests that their inner ears are well adapted for low frequency hearing. Models for some mysticetes suggest that they are capable of hearing within the mid-frequency range. Anatomical models predicted a functional range of hearing from 15 Hz to 18 kHz for right whales (Parks et al., 2007), a total range of hearing for the humpback whale from 30 Hz to 18 kHz (Helweg et al., 2000) and a region of best sensitivity for the humpback whale between 700 Hz and 10 kHz (Houser et al., 2001a). The suspicion that some mysticetes hear well at mid-frequencies is also supported by behavioral observations (e.g., the frequencies at which humpback whales sing).

Like mysticetes, odontocetes depend on acoustic perception and production for communication, food-finding, and probably for navigation and orientation. Many species are known to use high frequency clicks for echolocation. All odontocetes studied to date hear best in the mid- to high frequency range, and some are expected to be found at the USWTR sites. Odontocetes are, therefore, included for further evaluation.

3.3.2.5 Seabirds

As described in Subchapter 3.2, few of the bird species that occur off the coasts of Virginia, North Carolina, South Carolina, and Florida are present year-round. Most only congregate in these waters seasonally, while others migrate through the area or are only occasionally found there (i.e., vagrants).

There are limited data on hearing in seabirds and even less on underwater hearing. Studies with terrestrial species have shown that birds are highly sensitive to low frequency sound in the air, with an in-air maximum auditory sensitivity between 1 and 5 kHz for most bird species (NMFS, 2003). While it is likely that many diving birds can hear mid-frequency sound, there is no evidence that seabirds use sound underwater. A study examining the use of visual and acoustic deterrents to three species of seabirds showed that all three species responded to visual alerts, while only one species responded to acoustic alerts (Melvin et al., 1999). Further, overall acoustic deterrents have not been shown to be effective (Bull, 2006).

In addition, little published literature exists on the effects of underwater sound to diving birds. A review of available articles indicates that the most extensive research has focused on pile-driving and seismic surveys. During these studies, airguns have not caused any harm and explosives have resulted in injury only when the seabirds occurred near the detonation (Turnpenny and Nedwell, 1994). In general, seabirds spend a short period of time underwater and rarely fully submerge themselves while feeding. If they do submerge themselves, they typically perform such activities for a short period of time. For example, the northern gannet has the longest recorded dive depth and dive time of 15 m (49 ft) in 30 seconds (Mowbray, 2002). Few seabirds exploit the water column deeper than 20 m (66 ft), although some diving birds (primarily penguins and auks) regularly exceed 50 m (164 ft) (Wilson et al., 2002). It is therefore highly unlikely that a seabird would be exposed to active sonar while foraging due to the very short dive time and shallow dive depth. Seabirds in the water column are likely to move to other areas if disturbed. As the strength of sonar diminishes with distance, the ability to quickly and easily leave an area of disturbance would rapidly distance seabirds from any potential impacts.

The range area was checked to determine the presence of threatened and endangered species in order to consider disturbances to sensitive species. There are two seabird species listed as endangered or threatened that may be found in the range areas (see Subchapter 3.2.8.3). The Bermuda petrel does not occur at USWTR Sites A or B and is not expected to occur at the USWTR sites C and D, as is a pelagic species that occurs over deep offshore waters. The roseate tern is rare at all four USWTR sites and is unlikely to be found in the USWTR range, as foraging ranges do not extend more than 25 to 30 km (13 to 16 NM) from shore (USFWS, 2001c).

Seabirds were analyzed for potential effects associated with exposure to the active sonar as part of the environmental documentation of an Environmental Assessment issued by NMFS (2003). Although the potential hearing capability of seabirds was outside the proposed high frequency of 20 kHz, it was concluded effects were unlikely even if some diving birds were able to hear the signal for the following reasons:

- There is no evidence seabirds use underwater sound.
- Seabirds spend a small fraction of time submerged.
- Seabirds could rapidly fly away from the area and disperse to other areas if disturbed.

Based on these conclusions, it is scientifically appropriate to extend these reasons to mid-frequency active sonar. While it is possible that seabirds are likely to hear some mid-frequency sounds in-air, there is no scientific evidence to suggest birds can hear these sounds underwater. For these reasons, seabirds are not addressed further, from an acoustical perspective, in this report.

3.3.2.6 Summary of Acoustical Screening

The foregoing screening analysis determined whether a given species could occur within the geographic area influenced by the active acoustics on one of the four USWTR sites, and if it possessed some sensory mechanism that would allow it to perceive the USWTR's mid-frequency sounds. Those animals that were found to not occur in the geographic area or that could not perceive mid-frequency sound are excluded from further analysis from an acoustical perspective (Subchapter 4.3). Following is a summary of the acoustical screening results:

- **Invertebrates** – Invertebrates were categorically eliminated from further consideration from an acoustical perspective because mid-frequency sound of USWTR active sonar is not considered to be in the primary hearing register of those invertebrate species that may possess the ability to sense sound and the potential for effects is negligible for invertebrate species that may inhabit the area during USWTR operations.

- **Fish –** It is expected that most marine fish species cannot hear mid-frequency sound, and therefore cannot detect the mid-frequency active sonar used in USWTR. The results of several studies have indicated that acoustic communication and orientation of fishes, in particular of hearing specialists, may be limited by noise regimes in their environment. Further, some fish may respond behaviorally to varying sound frequencies, including possibly mid-frequency sources (similar to the sonar sources that would be used on the USWTR). Given these factors, fish are included for further analysis (Subchapter 4.3.11).

- **Sea Turtles –** Sea turtles were excluded from further analysis from an acoustic perspective because the best hearing range for sea turtles is most likely less than 1 kHz, which is below the level of projected sound sources on the USWTR. Thus, the potential for sea turtles to experience acoustic effects from USWTR operations is negligible. Sea turtles are not, therefore, addressed further from an acoustic-effects perspective in this OEIS/EIS.

- **Seabirds –** Seabirds were excluded from further analysis from an acoustic perspective because while it is likely that many diving birds can hear mid-frequency sound, there is no evidence that seabirds use sound underwater, or are deterred by sound. In addition, seabirds spend a very small fraction of their time submerged, and they can rapidly disperse to other areas if disturbed. For these reasons, seabirds are not addressed further from an acoustical perspective in this OEIS/EIS.

- **Marine Mammals –** Pinniped species are not likely to occur at the proposed USWTR sites; therefore, they were excluded from further evaluation from an acoustical perspective. Although manatees would not be present on the USWTR sites in some very limited instances they could be in coastal ocean waters. Mysticetes and odontocetes are expected to occur at the proposed USWTR sites. Most mysticete and odontocete species studied to date and manatees are suspected to hear in the mid- to high frequency range. Thus, mysticetes, odontocetes, and manatees are included for further evaluation from an acoustical perspective (Subchapters 4.3.8 and 4.3.9).

The method used to estimate potential acoustical effects on marine mammals includes several key steps, the first of which is to estimate the number and species of marine mammals that would be present in each USWTR area. As discussed in Chapter 2, the actual USWTR sites are much smaller areas within the larger OPAREAs. To accurately reflect the spatial resolution of the data, densities presented are for broad depth regimes in the entire Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs that correspond to the depths present at the potential USWTR sites off the east coast of the U.S. The following subchapter describes how densities were derived and presents tables that contain estimated densities for each OPAREA.

3.3.3 Estimated Marine Mammal Densities

Quantification of marine mammal density and abundance was primarily accomplished by evaluating line-transect survey data which was collected by NMFS, the Northeast and Southeast Fisheries Science Centers (NEFSC and SEFSC). The NEFSC and SEFSC are the technical centers within NMFS that are responsible for collecting and analyzing data to assess marine mammal stocks in the U.S. Atlantic EEZ.

These data sets were analyzed and evaluated in conjunction with regional subject matter experts, NMFS technical staff, and scientists with the University of St. Andrews, Scotland, Centre for Environmental and Ecological Modelling (CREEM). Methods and results are detailed in Navy OPAREA Density Estimate (NODE) reports covering all U.S. Atlantic coast OPAREAs. The potential USWTR locations are included in four of these OPAREAs (i.e., Jacksonville, Charleston, Cherry Point, and VACAPES).

Density estimates from previous Navy environmental documents were recently updated using the most advanced methodology currently available. Spatial modeling using Program DISTANCE (RUWPA), a program based on Buckland et al. (2001, 2004), is the primary method of density estimation used to produce the updated NODE reports. Together with appropriate line-transect survey data, this method provides the most accurate/up-to-date density information for marine mammals in U.S. Navy OPAREAs. The updated density estimate data presented in this final

OEIS/EIS are taken from the NODE report for the Southeast OPAREAs (DoN, 2007a), providing density estimates for the Jacksonville, Charleston, Cherry Point, and VACAPES OPAREAs.

The density estimates in the Southeast OPAREAs NODE report were calculated by a team of experts using survey data collected and provided by NMFS and with expert modeling support provided by CREEM. Researchers at CREEM are recognized as the international authorities on density estimation and have been at the forefront in development of new techniques and analytical methods for animal density, including spatial modeling techniques. Spatial modeling techniques have an advantage over traditional line-transect/distance sampling techniques in that they can provide relatively fine scale estimates for areas with limited or no available survey effort by creating models based on habitat parameters associated with observations from other surveys with similar spatial or temporal characteristics. Analysis of line-transect data in this manner allows for finer-scale spatial and/or temporal resolution of density estimates, providing indications of regions within the study area where higher and lower concentrations of marine mammals may occur rather than the traditional approach of generating a single estimate covering a broad spatial strata. These generic spatial strata tend to mask the finer scale habitat associations suggested by the specific ecology of an individual species.

Density estimates for cetaceans were derived in one of three ways, in order of preference:

- Through spatial models using line-transect survey data provided by the NMFS
- Using abundance estimates from Mullin and Fulling (2003), Fulling et al. (2003), and/or Mullin and Fulling (2004)
- Based on the cetacean abundance estimates found in the most current NOAA stock assessment report (SAR) (Waring et al., 2007)

For the model-based approach, density estimates were calculated for each species within areas containing survey effort. A relationship between these density estimates and the associated environmental parameters such as depth, slope, distance from the shelf break, SST, and chlorophyll *a* concentration was formulated using generalized additive models (GAMs). This relationship was then used to generate a two-dimensional density surface for the region by predicting densities in areas where no survey data exist. For the Southeast, all analyses for cetaceans were based on sighting data collected through shipboard surveys conducted by NMFS NEFSC and SEFSC between 1998 and 2005. Species-specific density estimates derived through spatial modeling were compared with abundance estimates found in the most current NOAA SAR to ensure consistency. NMFS technical staff reviewed all spatial models and density estimates. Table 3.3-3 contains a list of each species and the means by which their density was derived. For a more detailed description of the methodology involved in calculating the density estimates provided in this final OEIS/EIS, please refer to the NODE report for the Southeast OPAREAs (DoN, 2007a).

Table 3.3-3

Method of Density Estimation for each Species/Species Group in the Southeast OPAREAs

Model-Derived Density Estimates	Fin whale (*Balaenoptera physalus*) Sperm whale (*Physeter macrocephalus*) Beaked whales (Family Ziphiidae) Bottlenose dolphin (*Tursiops truncatus*) Atlantic spotted dolphin (*Stenella frontalis*) Striped dolphin (*Stenella coeruleoalba*) Common dolphin (*Delphinus delphis*) Risso's dolphin (*Grampus griseus*) Pilot whales (*Globicephala* spp.)
SAR or Literature-Derived Density Estimates	North Atlantic right whale (*Eubalaena glacialis*)[1] Humpback whale (*Megaptera novaeangliae*)[1] Minke whale (*Balaenoptera acutorostrata*)[2] *Kogia* spp.[2] Rough-toothed dolphin (*Steno bredanensis*)[2] Pantropical spotted dolphin (*Stenella attenuata*)[2] Clymene dolphin (*Stenella clymene*)[2]
Species for Which Density Estimates are not Available[3]	Blue whale (*Balaenoptera musculus*) Sei whale (*Balaenoptera borealis*) Bryde's whale (*Balaenoptera brydei/edeni*) Killer whale (*Orcinus orca*) Pygmy killer whale (*Feresa attenuata*) False killer whale (*Pseudorca crassidens*) Melon-headed whale (*Peponocephala electra*) Spinner dolphin (*Stenella longirostris*) Fraser's dolphin (*Lagenodelphis hosei*) White-beaked dolphin (*Lagenorhynchus albirostris)* Atlantic white-sided dolphin (*Lagenorhynchus acutus*) Harbor porpoise (*Phocoena phocoena*) West Indian manatee (*Trichechus manatus)*

Notes:
[1] Abundance estimates were geographically and seasonally partitioned
[2] Abundance estimates were uniformly distributed geographically and seasonally
[3] See DoN, 2007a for additional discussion
Source: DoN, 2007a

Temporal Distribution

Training at the proposed locations may occur throughout the year. In order to account for seasonal variability in the temporal distribution of marine mammals, it was necessary to partition the year appropriately. Density estimation was calculated by seasons defined by astronomical conventions, as follows:

- **Winter –** December 1 through February 28
- **Spring –** March 1 through May 31
- **Summer –** June 1 through August 31
- **Fall –** September 1 through November 30

3.3.3.1 Use of the “May Occur” Designation

For a given species, season, and depth stratum, the density estimate, based on available data, may be zero, and yet the data show that some sightings have been reported. There are also cases where reasoned judgment suggests that there is some likelihood that additional survey effort and data may yield sightings in heretofore unreported areas.

Applying reasoned judgment combined with other available information, the qualifying category of “may occur” is used to indicate that while the available data suggest that on any given day a species’ density is likely to be zero, over time, and particularly as new data become available, individuals of the species may indeed occur in this season and stratum.

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3.4 Socioeconomic Environment

This subchapter describes the socioeconomic environment at the four proposed USWTR sites. Activities within the sites that influence regional and local economies include federal agency usage, commercial fishing, recreational fishing, commercial shipping, recreational boating and scuba diving.

3.4.1 Federal Agency Usage

3.4.1.1 Site A

Site A is situated wholly within the Jacksonville OPAREA, which has been used extensively for military exercises. FACSFAC Jacksonville is the scheduling authority for the region.

3.4.1.2 Site B

Site B is situated wholly within the Charleston OPAREA, which has been used extensively for military exercises. FACSFAC Jacksonville is the scheduling authority for the region.

3.4.1.3 Site C

The proposed Site C USWTR falls wholly within the Cherry Point OPAREA, a major area of federal agency usage. The OPAREA has been used extensively for military exercises, primarily by the Navy. FACSFAC VACAPES is the scheduling authority for the region.

3.4.1.4 Site D

Site D is situated wholly within the VACAPES OPAREA. The VACAPES OPAREA is a major area of federal agency usage. The area has been used extensively for military/NASA training, testing, and ordnance and rocket firing exercises. FACSFAC VACAPES is the scheduling authority for the region.

The NASA Wallops Flight Facility (WFF) is located on Virginia's eastern shore and comprises three properties: the main base, the Mainland, and the Wallops Island launch site. WFF is NASA's principal facility for management and implementation of suborbital research programs (NASA, 2006). The facility supports science and exploration missions for NASA and other federal agencies, and supports Navy development tests and exercises. Normal operating hours at WFF are Monday through Friday, 6:00 am through 6:00 pm (NASA, 2006).

The U.S. Department of the Interior (DoI) proposes to allow oil and gas drilling in federal waters on the outer continental shelf in a lease sale area about 80 km (50 mi) off the coast of Virginia

(MMS, 2007b). Under a proposed final five-year oil and gas leasing program for 2007 to 2012, the lease sale off Virginia is scheduled for late 2011, although environmental and seismic studies could proceed before that year. The proposed lease sale area overlaps the seaward portion of Site B offshore of Virginia (Figure 3.4-1).

The proposed lease sale area is located within the Mid-Atlantic Planning Area.

3.4.2 Commercial Fishing

Data were collected on commercial fisheries landings, types of fishing gear used, fishing effort, and known popular fishing areas. The SAFMC manages fisheries in federal waters off of eastern Florida and Georgia (Site A), and off South Carolina (Site B). Both the MAFMC and the SAFMC manage fisheries in federal waters off the coast of North Carolina (Site C). The MAFMC manages fisheries in federal waters off the coasts of Virginia and Maryland (Site D). Both the ASFMC and NMFS manage select species at all four proposed USWTR sites.

FMPs are in force for several fisheries and regulate both commercial and recreational fishing. The objectives of the plans vary, but are generally geared towards ensuring the long-term sustainability of the subject fish species and meeting specific management goals. FMPs generally utilize geographic and seasonal fishery closures, catch limits and quotas, size and age limits, gear restrictions, and access controls to manage the fishery resources.

As described in Subchapter 3.2.4, the MAFMC has developed seven FMPs to promote the long-term health and stability of the managed fisheries (MAFMC, 2007). These FMPs include the following:

- Atlantic mackerel, squid, and butterfish
- Bluefish
- Spiny dogfish
- Atlantic surfclam and ocean quahog
- Summer flounder, scup, and black sea bass
- Tilefish
- Monkfish.

The nine FMPs developed by the SAFMC include the following (SAFMC, 2007b, 2008):

- South Atlantic snapper/grouper
- Coastal migratory pelagics
- Shrimp
- Calico scallop

Outer Continental Shelf Oil & Gas Leasing Program Area 2007-2012

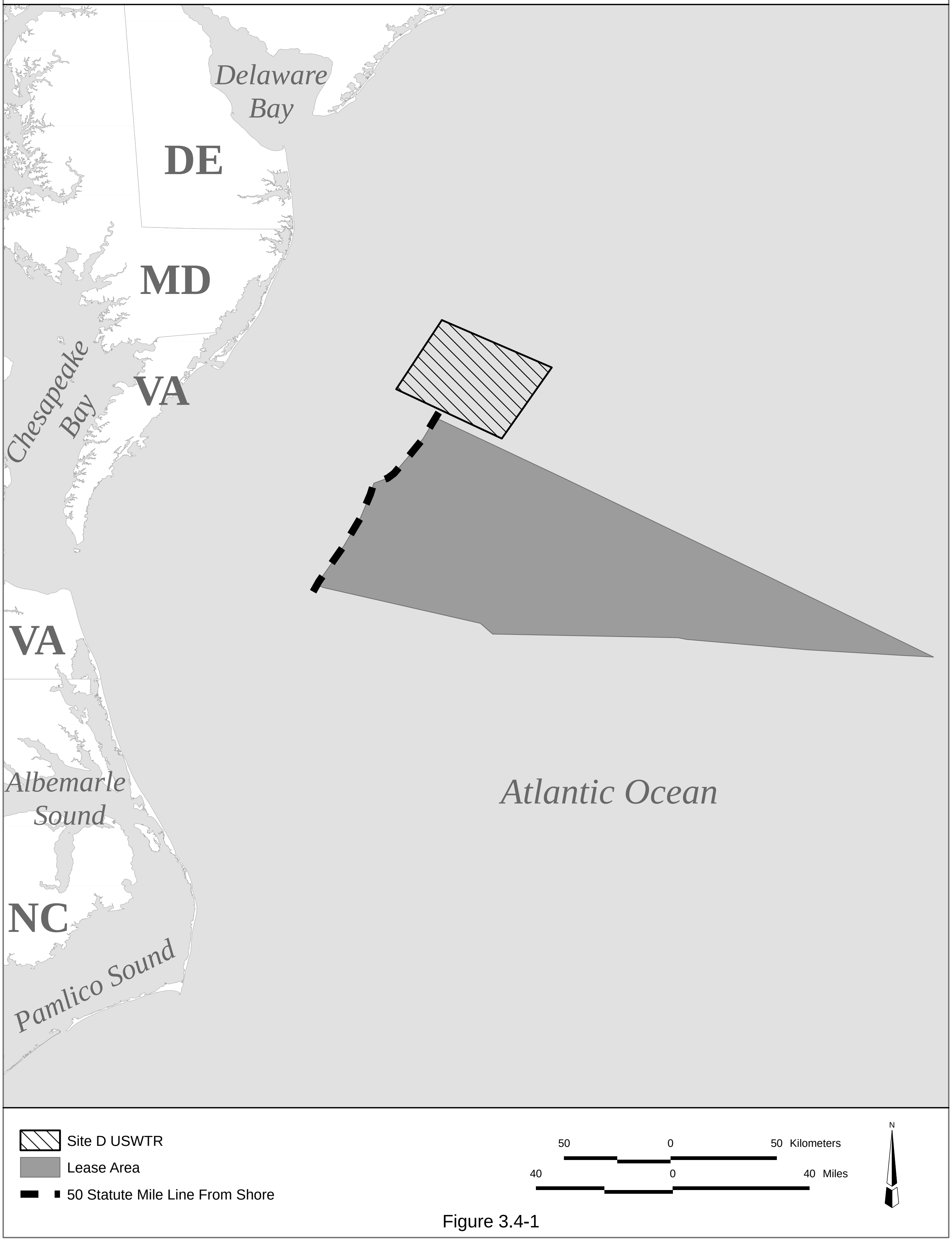


Figure 3.4-1

- Spiny lobster
- Golden crab
- Coral, coral reefs, and live/hard bottom habitat
- *Sargassum*
- Dolphinfish and wahoo.

The Interstate Fisheries Management Program (ISFMP) of the ASMFC manages 22 coastal fish species or species groups (ASMFC, 2007):

- American eel
- American lobster
- Atlantic croaker
- Atlantic herring
- Atlantic menhaden
- Atlantic sturgeon
- Black sea bass
- Bluefish
- Horseshoe crab
- Northern shrimp
- Red drum
- Scup
- Shad and river herring
- Spanish mackerel
- Spiny dogfish and coastal sharks
- Spot
- Spotted sea trout
- Striped bass
- Summer flounder
- Tautog
- Weakfish
- Winter flounder.

NMFS regulates highly migratory species (HMS) (NMFS, 2007c), including:

- Billfish
- Large coastal sharks
- Small coastal sharks
- Pelagic sharks
- Swordfish
- Tunas

- Prohibited species.

3.4.2.1 Site A

Extensive commercial fishing occurs along the east coast of Florida and the coast of Georgia, extending from the shore to well seaward of the proposed Site A USWTR. Dominant fisheries include shrimp, crab, mackerel, mullet, and swordfish. Gear types commonly used within the fisheries include otter trawls, hand lines, cast nets, pots and traps, and long lines (NMFS, 2007b). Bottom otter trawls, hand lines, cast nets, and pots and traps are used over the continental shelf, whereas pelagic long lines primarily target highly migratory species near and beyond the continental shelf edge (DoN, 2008n).

The majority of the commercial fishing grounds within the Jacksonville OPAREA are found over the continental shelf, or near areas of relief or bottom structure (DoN, 2008n). The commercial fishing grounds are similar to those used by recreational fishermen (DoN, 2008n). Popular fishing areas and their relative locations to the proposed Site A USWTR are shown in Figure 3.4-2. There are five charted popular fishing areas within the proposed Site A USWTR, including Roll Down.

The SAFMC manages fisheries in federal waters off the coasts of Florida and Georgia. The nine FMPs developed by the SAFMC identified in Subchapter 3.2.4 are applicable to the federal waters off the Florida and Georgia coasts. NMFS also regulates highly migratory species fisheries off Florida and Georgia (NMFS, 2007c).

State Landings

NMFS collects landings data from several sources, including state-mandated fishery or mollusk trip-tickets; landing weighout reports provided by seafood dealers; federal logbooks of fishery catch and effort; shipboard and portside interviews; and biological sampling of catches (NMFS, 2007b). These data are incorporated into the NMFS Statistics and Economics Division commercial landings databases. Two caveats are relevant to the interpretation of this data:

- Landings data do not indicate the location of capture. For example, fish landed in Florida could have been taken offshore of another state, but landed in Florida.

- Federal statutes prohibit public disclosure of landings that would allow identification of the data contributors and possibly put them at a competitive disadvantage. Total landings by state are accurate and comprise the sum of both non-confidential and confidential landings. However, whenever confidential landings occur, NMFS combines the confidential landings with other, non-confidential landings and usually reports the combined landings as unclassified. Therefore, landings reported by individual taxonomic groups or individual gear

Popular Fishing Areas in the Jacksonville OPAREA & Vicinity

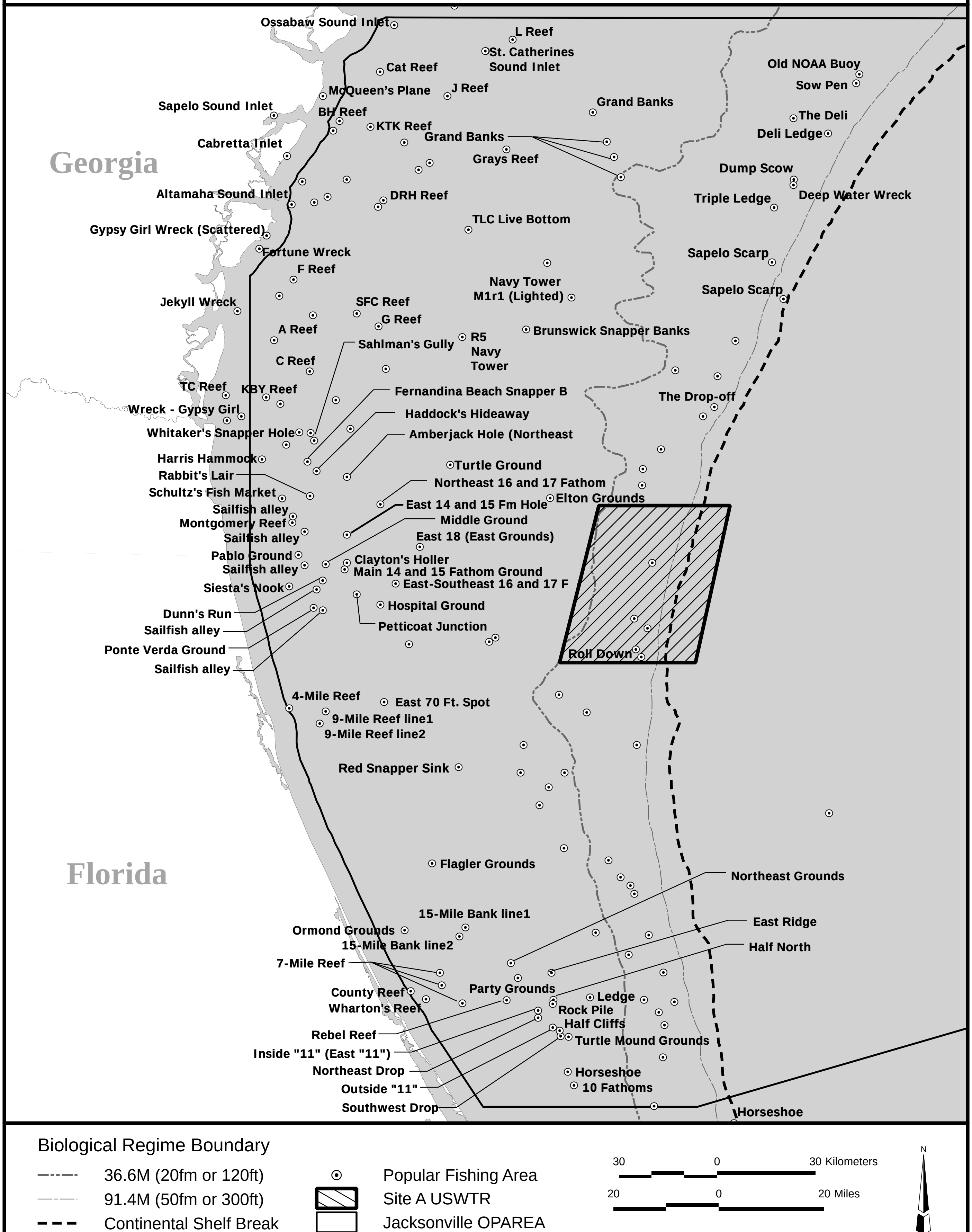


Figure 3.4-2

types may be misleading due to the exclusion of confidential landings from some groups or types.

NMFS (2007b) landings data for the coastal and offshore waters of the east coast of Florida and off the coast of Georgia were evaluated to determine the magnitude and value of the commercial marine fisheries. The most recent commercial fishing information for Florida available from NMFS was for the year 2006 (NMFS, 2007b, c). NMFS provides landings information for Florida separated by east and west coasts. Information specific to eastern Florida and Georgia is presented below. Detailed county economic information was not available for Florida or Georgia as it was for North Carolina (see Subchapter 3.4.2.3).

Eastern Florida

Over the ten-year period ending in 2006, the commercial landings of food and baitfish, measured by weight, averaged about 13 million kg (28 million lbs) per year. Commercial landings ranged between a high of nearly 15 million kg (33 million lbs) in 1997 and a low of less than 10 million kg (22 million lbs) two years later, in 2002. Over the ten-year period, landings typically deviated from the average by approximately 14 percent. The landings data show a marked overall declining trend of about 24 percent over the ten years.

Landings by value decreased along the east coast of Florida between 1997 and 2006 (NMFS, 2007b). The dollar values of landings declined at a substantial overall rate of over 27 percent during the decade. Dollar values averaged over $42 million. Values ranged from a high of over $52 million in 2000 to a low of approximately $33 million three years later, in 2003.

Marine fish and shellfish landings along the east coast of Florida are far less seasonal, compared to South Carolina, North Carolina, Maryland, and Virginia marine fisheries. In 2006, over 22 percent of the landings, measured by weight, were recorded in December and January, the months with the highest landings along the east coast of Florida. The value of landings was highest in August and December with 11 percent of the total annual landings occurring in each of these months. Landings in other months ranged between 6 percent and 9 percent of the annual value and weight. Lowest values and weights occurred in February and March.

Over the ten-year period ending in 2006, the 10 species of finfish and shellfish that generated the most revenue comprised over 70 percent of the commercial landings along the east coast of Florida, (Table 3.4-1). Landings for these ten principal species averaged almost $30 million, a considerable amount compared to the average annual commercial landings of more than $42 million for all species.

Table 3.4-1

1997-2006 Average Annual Landings of 10 Principal Species – Florida East Coast

Species	Landings by Value Thousand $	Percentage of Total Landings
10 Principal Species	29,750	70.3
White shrimp	8,101	19.1
Rock shrimp	3,968	9.4
Blue crab	3,788	9.0
King and cero mackerel	3,332	7.9
Swordfish	2,294	5.4
Caribbean spiny lobster	2,257	5.3
Brown shrimp	1,736	4.1
Quahog clam	1,557	3.7
Spanish mackerel	1,420	3.4
Dendrobranchiata shrimp	1,295	3.1
Other Species	12,570	29.7
Total – All Species	42,320	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

In terms of commercial landings by measured value, white shrimp was the dominant species, comprising over 19 percent of the average landings along the east coast of Florida. Rock shrimp was the second most dominant species, comprising 9 percent of the average annual landings. The eight other principal species accounted for about 42 percent of the total landings.

In 1995, NMFS began collecting and reporting data so that catches made in state waters (usually 0 to 5.6 km [0 to 3 NM] from shore) could be differentiated from those of federal waters (5.6 to 370 km [3 to 200 NM] from shore) and the high seas (greater than 370 km [200 NM] from shore). While the landings reported are preliminary and still subject to change (NOAA Fisheries, 2004), they provide an indication of how the catch is distributed between these zones.

In terms of weight, about 44 percent of the landings along the east coast of Florida in 2006 were from state waters; approximately 56 percent were from federal waters (Table 3.4-2). When compared to the value of catches from state waters, the relative importance of catches from federal waters was slightly more pronounced, representing almost 60 percent of the value of the landings.

Table 3.4-2

2006 Commercial Landings by Distance – Florida East Coast

	Landings by Weight				Landings by Value		
	Thousands of Kilograms	Thousands of Pounds	% of Area Landings	% of Total Landings	Thousands of Dollars	% of Area Landings	% of Total Landings
State Waters							
Finfish	2,402	5,295	45.3	20.1	5,224	29.9	12.1
Shellfish	2,894	6,381	54.7	24.2	12,244	70.1	28.4
Total	5,296	11,676	100.0	44.3	17,468	100.0	40.5
Exclusive Economic Zone							
Finfish	3,743	8,252	56.3	31.3	12,523	48.8	29.1
Shellfish	2,910	6,415	43.7	24.4	13,116	51.2	30.4
Total	6,653	14,667	100.0	55.7	25,639	100.0	59.5
Grand Total	11,949	26,343		100.0	43,107		100.0

Notes: Numbers may not total exactly due to rounding.
No landings from the high seas were reported.
Source: NMFS, 2007b.

In 2006, shellfish dominated the catch in state waters, comprising approximately 55 percent of the landings by weight and 70 percent by value. In federal waters, finfish dominate, comprising about 56 percent of the catch by weight and 76 percent of the catch by value. However, finfish comprised nearly the same share of the revenue as shellfish accounting for approximately 49 percent of the value of the landings. Most (60 percent) of the finfish and shellfish landed on the east coast of Florida were caught in federal waters.

Georgia

Between 1997 and 2006, the commercial landings of food and baitfish in Georgia, measured by weight, averaged about 5 million kg (11 million lbs). Commercial landings peaked in 1997 at approximately 7 million kg (15 million lbs), while the lowest landings occurred in 2006, when about 4 million kg (8 million lbs) of finfish and shellfish were landed.

Harvests were variable over the decade, with annual landings typically having deviated from the average by about 19 percent. The landings data show a marked overall declining trend of approximately 36 percent over the ten years.

The dollar values of the landings averaged approximately $18 million over the ten-year period. Total values ranged from a low of about $4 million in 2006 to a high of approximately $7 million in 1997. Landings by value decreased at a rate of almost 57 percent over the ten years.

Marine finfish and shellfish landings in Georgia are seasonal. In terms of landings by month, with 28 percent of total landings by weight, September and October were the peak months in Georgia during 2006. Lowest landings by weight were reported for March and April, with a combined total of about 8 percent of the 2006 landings. The highest landings by value were reported in September and October, when 29 percent of the value of the catch was landed, while the lowest landing by value were reported in March and April, with approximately 7 percent of the catch.

Between 1997 and 2006, 99 percent of the commercial landings in Georgia, measured by value, were attributed to ten species of finfish and shellfish (Table 3.4-3). Over the ten-year period, landings for these ten principal species averaged approximately $18 million in annual commercial landings.

Table 3.4-3

1997-2006 Average Annual Landings of 10 Principal Species – Georgia

Species	Landings by Value Thousand $	Percentage of Total Landings
10 Principal Species	17,750	99.0
White shrimp	11,132	62.1
Blue crab	2,778	15.5
Brown shrimp	1,935	10.8
Dendrobranchiata shrimp	618	3.4
Unclassified finfishes	510	2.8
Quahog clam	301	1.7
Snails (conchs)	187	1.0
Vermilion snapper	149	0.8
Other marine shrimp	91	0.5
Unclassified shellfish	49	0.3
Other Species	178	1.0
Total – All Species	17,928	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

White shrimp was the dominant species by value in Georgia, and blue crab was the second most dominant species. With average landings of over $11 million, white shrimp comprised about 62 percent of the landings. Blue crabs comprised about 16 percent of the landings, with average landings of nearly $3 million. The eight other principal species accounted for over 21 percent of the total landings.

By weight, about 66 percent of the landings in Georgia in 2006 were from state waters; approximately 34 percent were from federal waters (Table 3.4-4). By value, landings from state waters accounted for nearly 53 percent of the total value of the Georgia marine fisheries, whereas landings from federal waters amounted to over 47 percent.

In 2006, shellfish dominated the catch measured by weight and by value in Georgia state waters, representing approximately 98 percent of the catch. Finfish comprised just 2 percent of the catch.

Table 3.4-4

2006 Commercial Landings by Distance – Georgia

	Landings by Weight				Landings by Value		
	Thousands of Kilograms	Thousands of Pounds	% of Area Landings	% of Total Landings	Thousands of Dollars	% of Area Landings	% of Total Landings
State Waters							
Finfish	46	102	1.9	1.2	148	2.4	1.3
Shellfish	2,422	5,339	98.1	64.4	5,948	97.6	51.6
Total	2,468	5,441	100.0	65.6	6,096	100.0	52.9
Exclusive Economic Zone							
Finfish	83	182	6.4	2.2	426	7.8	3.7
Shellfish	1,211	2,670	93.6	32.2	5,011	92.2	43.4
Total	1,294	2,852	100.0	34.4	5,437	100.0	47.1
Grand Total	3,762	8,293		100.0	11,533		100.0

Notes: Numbers may not total exactly due to rounding.
No landings from the high seas were reported.
Source: Elizabeth S. Pritchard, NMFS Office of Science and Technology, email to author, February 2, 2009.

The majority of the catch in federal waters, by weight and by value, was shellfish. By weight, nearly 94 percent of the landings from federal waters were shellfish, and over 6 percent were finfish. When measured by value, shellfish accounted for over 92 percent of the total landings from federal waters.

Fishing Gear and Fishing Effort

Eastern Florida

The principal gears used to harvest finfish and shellfish landed along the east coast of Florida are otter trawls, pots and traps, hand lines, and long lines (Table 3.4-5). From 1997 through 2006, 37 percent of landings by value, of the fish landed in the state were captured using otter trawls, while pots and traps, hand lines, and long lines were used to capture 15, 13, and 10 percent, respectively.

Table 3.4-5

1997-2006 Average Annual Commercial Landings by Gear Type – Florida East Coast

Gear Type	Landings by Value Thousand $	Percentage of Total Landings
Otter trawl bottom	15,636	37.0
Pots and traps	6,243	14.8
Hand lines	5,672	13.4
Long lines	4,416	10.4
Cast nets	2,108	5.0
Gill nets	1,513	3.6
Rod and reel	1,473	3.5
By hand, other	1,341	3.2
Diving outfits	1,214	2.9
Beam trawls	800	1.9
Butterfly nets	514	1.2
Other gear types	1,378	3.3
Total – All Gear	42,309	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Georgia

The principal commercial gears used to harvest the marine fishery resources of Georgia are otter trawls, and pots and traps (Table 3.4-6). Most fish and shellfish landed in Georgia, as measured by value, were captured using otter trawls, with nearly 78 percent of the fish and shellfish landed in the state having been captured by otter trawls. Approximately 16 percent of the landed fish and shellfish were captured using pots and traps.

Table 3.4-6

1997-2006 Average Annual Commercial Landings by Gear Type – Georgia

Gear Type	Landings by Value Thousand $	Percentage of Total Landings
Otter trawl bottom	13,912	77.7
Pots and traps	2,778	15.5
Hand lines	437	2.4
By hand, other	324	1.8
Electric or hydraulic reel	207	1.2
Cast nets	156	0.9
Gill nets	52	0.3
Unspecified trawls	10	0.1
Other gear types	24	0.1
Total – All Gear	17,901	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

Fisheries within Range Site A

Table 3.4-7 presents the geographical overlap of the fishing grounds within Site A compared to the extent of the grounds off the coastline of Florida. Hook-and-line type fishing vessels are abundant in Site A. Handline landings are higher off the east coast of Florida compared to North Carolina, Maryland, and Virginia. A variety of fish species were caught in the east coast of Florida hand lines fishery between 1997 and 2006. King and cero mackerel dominated the catch from this fishery, comprising more than 47 percent of the catch, measured by value.

Table 3.4-7

Geographical Overlap of Fishing Grounds
Within Site A

Gear Type	Percentage Overlap
Bottom long line for reef fish	8
Bottom long line for shark	5
Bottom trawling for shrimp, scallops	10
Hand line, rod and reel, trolling	12

Trawling for shrimp is quite common in Florida. Brown and white shrimp fisheries occur from inshore out to a depth of about 18.3 m (60 ft) and do not overlap Site A. Pink shrimp are most abundant between depths of 11 and 37 m (36 and 121 ft), but can occur as deep as 65 m (213 ft) (SAFMC, 2004a) and do overlap Site A.

Rock shrimp and royal red shrimp are found in the deeper water off of Florida and these fisheries occur in Site A. Rock shrimp are caught between the latitudes of 35°N and 27°N. The majority are caught around 28°N off of Cape Canaveral (SAFMC, 1996). The largest concentrations of rock shrimp are found at depths between 35 and 55 m (115 and 180 ft). Most rock shrimp are caught south of the range area, although some may be caught within more shallow areas of the range site in years of abundance.

The royal red shrimp fishery is concentrated in waters from 329 to 421 m (1,079 to 1,381 ft) deep; however, the fishery can occur from 180 to 730 m (590 to 2,395 ft). This depth of concentrated fishing, while greater than the USWTR site (289 m [948 ft]), is quite close to Site A because the shelf drops off quite quickly. This is a gear-intensive fishery with more than a mile of cable required to drag trawls over the bottom. There is the potential to damage cables or sensor nodes if gear were to be dropped on them or if trawls were drawn over them. A boat can overturn quickly in dangerous conditions and crews will attempt to drop their gear (estimated at a value of $40,000) rather than capsizing. Off the east coast of Florida, royal red shrimp are most often fished from Jacksonville to Ft. Pierce.

Trawling for calico scallops in Florida is focused south of Site A, although calico scallops do occur even further north of Site A and, in years of abundance, bottom trawling occurs within Site A. Calico scallops are found at depths between 9 and 366 m (30 and 1,200 ft). Pelagic longline fishing does not occur in Site A as it is not allowed within the site area. Bottom longline gear, however, is allowed and does occur in Site A at depths of 91 to 273 m (300 to 895 ft). Pot and trap fishing and gillnetting occur inshore off of Jacksonville, Florida and the fishing areas do not overlap Site A.

3.4.2.2 Site B

Principal fishery resources on the continental shelf offshore of South Carolina include several open ocean and migratory pelagic, demersal, and reef finfish species, as well as shrimp. The largest and most economically valuable fishery in South Carolina is that for white and brown shrimp (South Carolina Sea Grant, 2007). Methods employed to catch these penaeid shrimp range from large shrimp trawlers to cast nets and drop nets (South Carolina Department of Natural Resources [SCDNR], 2007). This fishery occurs primarily inshore of the proposed range area. A rock shrimp fishery, however, may occur sporadically off of South Carolina in waters from 27 to 55 m (90 to 180 ft), and therefore overlap the more shallow areas of the proposed range (SAFMC, 2004; SCDNR, 2007).

Other fisheries include pelagic and bottom longliners targeting fishes near the shelf edge. Over the continental shelf, many commercial species are fished over areas of bottom relief, such as canyons, outcroppings, rock rubble, artificial reefs, and shipwrecks. Species commonly fished in these areas are those in the snapper-grouper complex. Hook-and-line and pot trapping methods are most often employed. These areas can be very similar to those used by recreational fishermen and are considered to be popular fishing areas, or fish havens (DoN, 2008n). Popular fishing areas and their relative locations to the proposed Site B USWTR are shown in Figure 3.4-3. As shown in Figure 3.4-3, there are 10 charted popular fishing areas within the proposed USWTR site.

State Landings

NMFS (2007b) landings data for the coastal and offshore waters of South Carolina were evaluated to determine the magnitude and value of the commercial marine fisheries. The most recent commercial fishing information for South Carolina available from NMFS was for the year 2006 (NMFS, 2007b). Monthly landing statistics, however, were only available as recently as 2005 (NMFS, 2007b). Detailed county economic information was not available for South Carolina as it was for North Carolina (see Subchapter 3.4.2.3).

Over the ten-year period ending in 2006, the commercial landings of food and baitfish, measured by weight, averaged about 6 million kg (14 million lbs) per year. Commercial landings ranged between a high of over 8 million kg (18 million lbs) in 1999 and a low of less than 4 million kg (10 million lbs) six years later, in 2005.

Harvests were variable over the ten-year period ending in 2006, with annual landings typically deviating from the average by approximately 20 percent. The landings data show an overall declining trend of about 43 percent over the ten years.

Just as landings by weight declined over the decade, the dollar values of landings also declined at a substantial overall rate of approximately 46 percent during the period (NMFS, 2007b). Dollar values averaged over $24 million. Values ranged from a high of over $32 million in 1997 to a low of approximately $15 million in 2005.

Marine finfish and shellfish landings in South Carolina are seasonal. In 2006, landings were highest in September and October, as measured by weight, with over 11 percent of the total annual landings occurring in each of these months. The value of landings was highest in May with nearly 13 percent of the total annual landings. In terms of both weight and value, the lowest landings occurred in April, with approximately 3 percent of the landings by weight and about 5 percent of the landings by value.

Over the ten-year period ending in 2006, the ten species of finfish and shellfish that generated the most revenue comprised over 83 percent of the commercial landings in South Carolina, measured by value (Table 3.4-8). Landings for these ten principal species averaged almost $20 million, a substantial amount of the average annual commercial landings of more than $24 million for all species.

Table 3.4-8

1997-2006 Average Annual Landings of 10 Principal Species – South Carolina

Species	Landings by Value Thousand $	Percentage of Total Landings
10 Principal Species	21,808	90.4
White shrimp	9,467	39.3
Blue crab	4,591	19.0
Brown shrimp	2,510	10.4
Quahog clam	1,874	7.8
Eastern oyster	1,058	4.4
Swordfish	583	2.4
Gag	532	2.2
Unclassified finfishes	514	2.1
Scamp	413	1.7
American shad	267	1.1
Other Species	2,312	9.6
Total - All Species	24,120	100.0
Notes: Numbers may not total exactly due to rounding. Source: NMFS, 2007b.		

In terms of commercial landings by value, white shrimp was the dominant species, comprising over 39 percent of the average landings in South Carolina. Blue crab was the second most dominant species, comprising 19 percent of the average annual landings. The eight other principal species accounted for about 32 percent of the total landings.

In terms of weight, about 78 percent of the landings in South Carolina in 2006 were from state waters; approximately 22 percent were from federal waters (Table 3.4-9). When compared to the value of catches from federal waters, the relative importance of catches from state waters was slightly less pronounced, representing almost 62 percent of the value of the landings.

Shellfish dominated the catch in state waters, comprising approximately 95 percent of the landings by weight and 61 percent by value. In federal waters, finfish dominated, comprising about 96 percent of the catch by weight and 52 percent of the catch by value.

Popular Fishing Areas in the Charleston OPAREA & Vicinity

Figure 3.4-3

Table 3.4-9

2006 Commercial Landings by Distance – South Carolina

	Landings by Weight				Landings by Value		
	Thousands of Kilograms	**Thousands of Pounds**	**% of Area Landings**	**% of Total Landings**	**Thousands of Dollars**	**% of Area Landings**	**% of Total Landings**
State Waters							
Finfish	204	450	5.2	4.0	374	2.5	1.6
Shellfish	3,736	8,237	94.8	74.1	14,658	97.5	60.9
Total	3,940	8,687	100.0	78.2	15,032	100.0	62.4
Exclusive Economic Zone							
Finfish	1,054	2,323	95.8	20.9	4,742	52.4	19.7
Shellfish	46	102	4.2	0.9	4,313	47.6	17.9
Total	1,100	2,425	100.0	21.8	9,055	37.6	37.6
Grand Total	5,040	11,112		100.0	24,087		100.0

Notes: Numbers may not total exactly due to rounding. No landings from the high seas were reported.
Source: NMFS, 2007b.

Fishing Gear and Fishing Effort in South Carolina

The principal gears used to harvest finfish and shellfish landed in South Carolina are otter trawls, pots and traps, and unspecified gear (Table 3.4-10). From 1997 to 2006, over 44 percent of the finfish and shellfish landed in state waters were captured using otter trawls, while pots and traps were used to capture 18 percent. An average of 11 percent of the gear used over the decade was unspecified.

Fisheries within Range Site B

Table 3.4-11 presents the geographical overlap of the fishing grounds within Site B compared to the extent of the grounds off the coastline of South Carolina. Hook-and-line, pelagic longline and bottom longline type fishing vessels are the most common in Site B.

The most common gear types used in the state are otter trawls and pots and traps; however, both of these fishing methods occur primarily inshore of the range site. Rock shrimp trawling may occur sporadically at depths of 27 to 55 m (90 to 180 ft), yet this fishery has not occurred in recent years. Landings of rock shrimp have not been reported in South Carolina since 1989. This fishery is more active in Florida waters.

Table 3.4-10

1997-2006 Average Annual Commercial Landings by Gear Type – South Carolina

Gear Type	Landings by Value Thousand $	Percentage of Total Landings
Otter trawl bottom	10,630	44.0
Pots and traps	4,386	18.2
Unspecified Gear	2,595	10.7
By Hand, Other	2,134	8.8
Rod and reel	1,695	7.0
Long lines	1,304	5.4
Tongs, grabs and rakes	370	1.5
Hand lines	340	1.4
Gill nets	244	1.0
Dredge	192	0.8
Other gear types	262	1.1
Total - All Gear	24,150	100.0
Notes: Numbers may not total exactly due to rounding. Source: NMFS, 2007b.		

Table 3.4-11

Geographical Overlap of Fishing Grounds within Site B

Gear Type	Percentage Overlap
Pelagic longline	4
Handline, rod and reel, trolling	9
Bottom longline	8

Snapper-grouper fishing is a common activity in the range site. Snapper-grouper fishermen fish in waters over Site B, between 91 and 183 m (300 and 600 ft), using bottom longlines, handlines, hook-and-line gear, and hydraulic reels. Fishermen target areas of bottom relief which are plentiful in Site B.

Other common fishing methods employed in Site B are pelagic and bottom longline fishing. Pelagic longline fishing occurs over the continental shelf break and in other areas of the Gulf Stream. Bottom longline fishing occurs in Site B at depths of 91 to 273 m (300 to 895 ft). Longliners target swordfish, tuna, sharks, and, to a lesser extent, reef fish.

3.4.2.3 Site C

Principal fishery resources on the continental shelf offshore of North Carolina include several open ocean and migratory pelagic, demersal, and reef finfish species, as well as shrimp, and scallops. Most commercial fishing in the Cherry Point OPAREA occurs on the continental shelf (DoN, 2008l). Pelagic and bottom longliners, rod and reel, and bottom trawlers target fishes near and beyond the shelf edge. 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 areas used by recreational fishermen and are considered to be popular fishing areas, or fish havens (DoN, 2008l). These popular fishing areas and their relative locations to the proposed Site C USWTR are shown in Figure 3.4-4. Ten charted popular fishing areas are located within the proposed USWTR site, including Swansboro Hole, Grouper Hole, Yellowfin Hole, Deep Ledge, and Scallop Bed.

State Landings

The most recent available commercial fishing information for North Carolina from NMFS was for the year 2006 (NMFS, 2007b). Over the ten-year period from 1997 to 2006, the commercial landings of food and baitfish in North Carolina, measured by weight, averaged about 65 million kilograms (kg) (144 million pounds [lbs]) per year (NMFS, 2007b). Commercial landings ranged between a high of about 104 million kg (230 million lbs) in 1997 to a low of approximately 31 million kg (69 million lbs) nine years later, in 2006.

Harvests were variable over the ten-year period ending in 2006, with annual landings, measured by weight, typically deviating from the average by approximately 32 percent. The landings data show an overall declining trend of about 60 percent over the ten years.

Just as landings by weight declined over the decade, the dollar values of landings also declined at a substantial overall rate of approximately 37 percent during the period (NMFS, 2007b). Dollar values averaged over $90 million. Values ranged from a high of over $109 million at the beginning of the ten-year period, in 1997, to a low of about $65 million towards the end of the period, in 2005.

Marine fish and shellfish landings in North Carolina are seasonal, both in terms of landings by weight and landings by value (NMFS, 2007b). In 2006, approximately one-third of the landings, measured by weight, were recorded in August, September, and October, the months with the highest landings; about 5 percent of the landings were recorded in April, December, and January, the months with the lowest landings. However, the value of landings peaked in May and July, with almost 23 percent of the total landings occurring within these months. Overall, landings by weight increased from lows in November, December and January until they peaked in October with the exception of a decrease in landings in April and May.

Over the ten-year period ending in 2006, the ten species of finfish and shellfish that generated the most revenue comprised almost 78 percent of the commercial landings in North Carolina, measured by value (Table 3.4-12). Landings for these ten principal species averaged about $70 million, a substantial amount compared to the average annual commercial landings of approximately $90 million for all species.

Table 3.4-12

1997-2006 Average Annual Landings of 10 Principal Species – North Carolina

Species	Landings by Value Thousand $	Percentage of Total Landings
10 Principal Species	69,864	77.5
Blue crab	32,409	35.9
Brown shrimp	5,993	6.6
Summer flounder	5,826	6.5
Southern flounder	5,205	5.8
White shrimp	4,052	4.5
Other marine shrimp	3,963	4.4
Quahog clam	3,870	4.3
Menhaden	3,629	4.0
Atlantic croaker	3,265	3.6
King and cero mackerel	1,652	1.8
Other Species	20,331	22.5
Total – All Species	90,194	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

In terms of commercial landings by value, the blue crab was the dominant species, comprising almost 36 percent of the total landings in North Carolina between 1997 and 2006. Brown shrimp was the second most dominant species, comprising about 7 percent by value of the total landings. The eight other principal species accounted for about 35 percent of the total landings.

The data indicate that, in terms of weight, about 64 percent of the landings in North Carolina in 2006 were from state waters; approximately 36 percent were from federal waters (Table 3.4-13). Landings measured by value show similar ratios of importance to total North Carolina landings.

Shellfish dominated the catch in state waters, comprising 72 percent by weight. The economic value of landings from state waters was also dominated by shellfish, which accounted for 77 percent of the dollars generated from all landings from state waters. In federal waters, finfish represented over 94 percent of the value of the landings. Finfish also dominated the catch by weight in federal waters with 95 percent of the catch. Overall, most (64 percent) finfish and shellfish were caught in state waters.

Popular Fishing Areas in the Cherry Point OPAREA & Vicinity

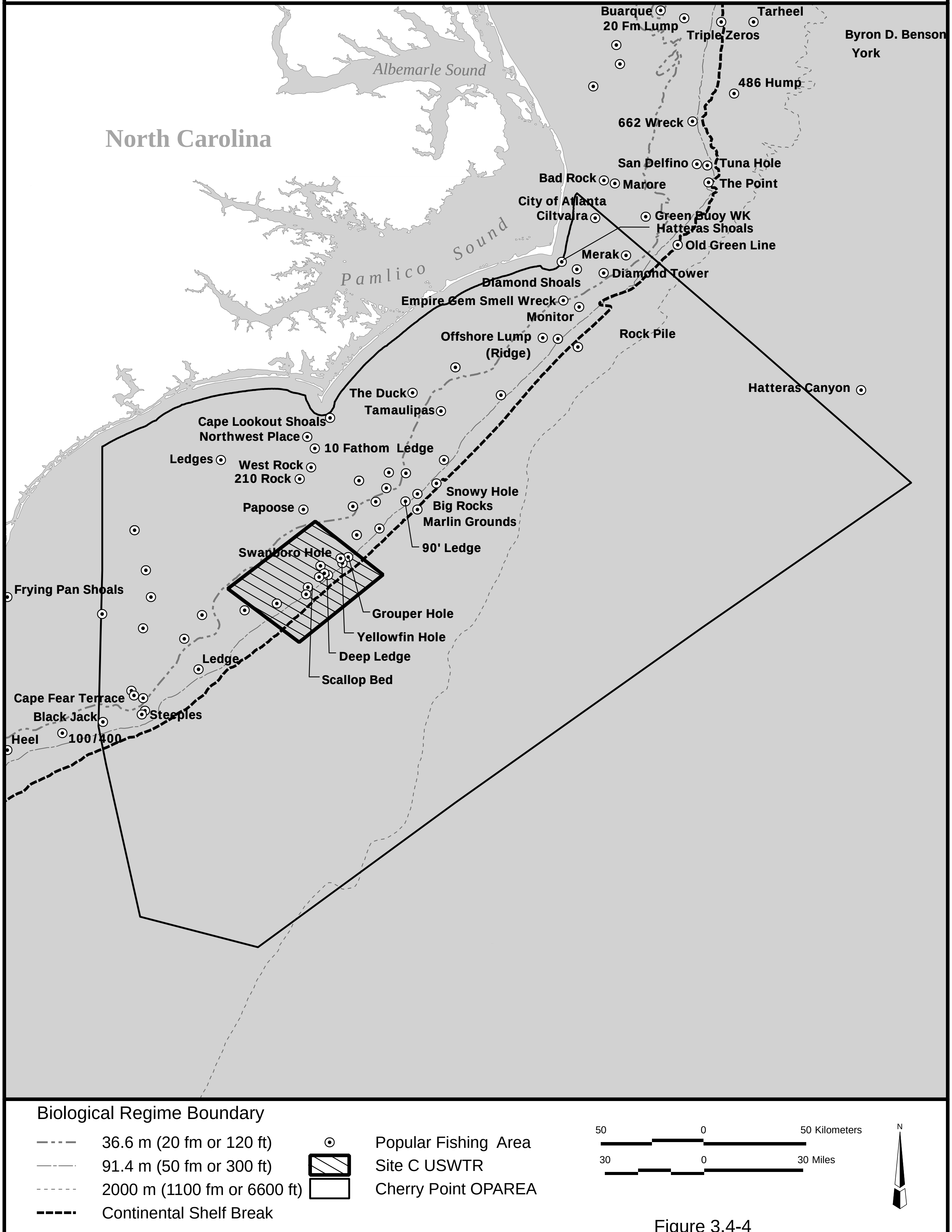


Figure 3.4-4

Table 3.4-13

2006 Commercial Landings by Distance – North Carolina

	Landings by Weight				Landings by Value		
	Thousands of Kilograms	Thousands of Pounds	% of Area Landings	% of Total Landings	Thousands of Dollars	% of Area Landings	% of Total Landings
State Waters							
Finfish	5,613	12,375	28.0	18.0	10,487	22.7	14.6
Shellfish	14,447	31,851	72.0	46.4	35,766	77.3	49.8
Total	20,060	44226	100.0	64.4	46,253	100.0	64.3
Exclusive Economic Zone							
Finfish	10,524	23,201	95.0	33.8	24,164	94.3	33.6
Shellfish	551	1,214	5.0	1.8	1,468	5.7	2.0
Total	11,075	24,415	100.0	35.6	25,632	100.0	35.7
Grand Total	31,135	68,641		100.0	71,885		100.0

Notes: Numbers may not total exactly due to rounding.
No landings from the high seas were reported.
Source: NMFS, 2007b.

Fishing Gear and Fishing Effort in North Carolina

The principal gears used to harvest the finfish and shellfish landed in North Carolina are pots and traps, otter trawls, and gill nets (Table 3.4-14). Between 1997 and 2006, approximately 36 percent of the finfish and shellfish landed in the state were captured using pots and traps, while otter trawls, and gill nets were used to capture 27 and 12 percent, respectively. However, in waters greater than 5.6 km (3 NM) from the coast, south of Cape Hatteras, (the area of Site C), rod and reel and trolling gear dominated from 1995 to 2004 (Figures 3.4-5 and 3.4-6).

Table 3.4-14

1997-2006 Average Annual Commercial Landings by Gear Type – North Carolina

Gear Type	Landings by Value Thousand $	Percentage of Total Landings
Pots and traps	32,249	36.2
Otter trawl	24,047	27.0
Gill nets	10,839	12.2
Hand lines	3,599	4.0
Long lines	3,199	3.6
Troll lines	2,637	3.0
Purse seines	2,493	2.8
Pound nets	2,057	2.3
Rakes	1,854	2.1
By hand, other	1,745	2.0
Clam dredge	1,263	1.4
Beach haul seine	1,073	1.2
Other gear types	1,935	2.2
Total – All Gear	88,990	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

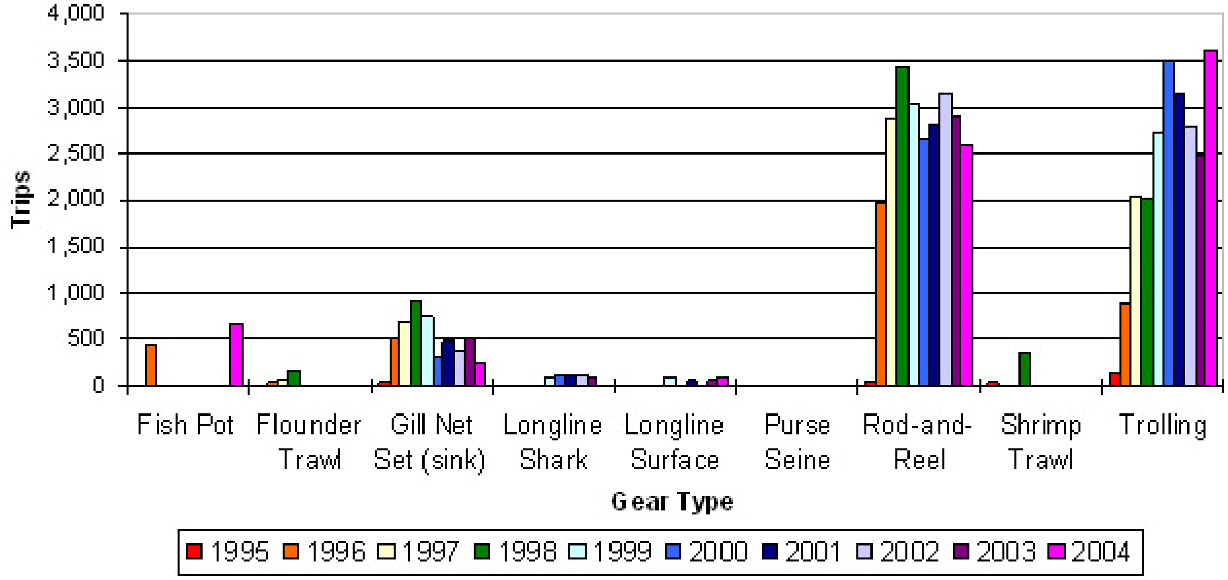
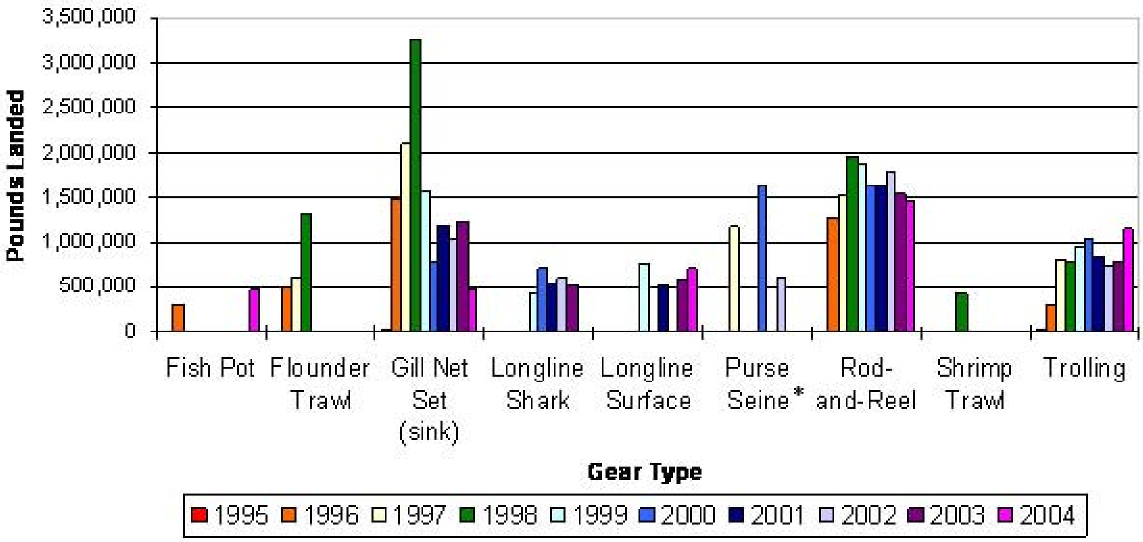


Figure 3.4-5

Commercial Trips Made by Major Gears from 1995 to 2004 for Ocean Areas Greater than 3 miles from shore, South of Cape Hatteras, North Carolina (North Carolina Division of Marine Fisheries [NCDMF], 2005b)

Note: Trips are shown for top 5 gear types of each year.



* Purse seine landing data are confidential. The values presented in the figure are approximate.

Figure 3.4-6

Commercial Landings Made by Major Gears from 1995 to 2004 for Ocean Areas Greater than 3 miles from Shore, South of Cape Hatteras, North Carolina (NCDMF, 2005b)

The NCDMF maintains a database of commercial fishing activity, which provided information to determine the number of commercial fishing vessels operating in and the number of commercial fishing trips that were reported for the Onslow Bay region. The findings for 2003 are presented in Table 3.4-15. During that year, 1,088 commercial fishing vessels landed their catches.

Table 3.4-15

2003 Commercial Fishing Vessels and Trips – North Carolina

County	Less than 5.6 km (3 NM)		Greater than 5.6 km (3 NM)	
	Number of Vessels	Number of Trips	Number of Vessels	Number of Trips
Carteret	171	943	309	1,955
Onslow	62	1,447	82	938
Pender	16	68	28	231
New Hanover	49	792	146	1,110
Brunswick	86	1,532	139	1,094
Total	384	4,782	704	5,328
Source: Bianchi, July 7, 2004.				

These vessels made approximately 10,110 trips during the subject period. A trip can last from a few hours to a few days, depending on the fishery (Gibson, 1996). Approximately 47 percent of the trips yielded catches made mostly in ocean waters less than 5.6 km (3 NM) from shore. The remainder of the trips, about 53 percent, resulted in catches made mostly in ocean waters at a greater distance from shore. These data suggest the relative magnitude of fishing activity, but cannot be used to quantify the actual use of the proposed range area by fishing vessels.

Fisheries within Range Site C

The majority of fish and shellfish caught in Onslow Bay are shrimp and snapper-grouper complex species. Trawling occurs at Site C for shrimp and occasionally calico scallops. Most shrimp fishing is done inshore, but fishermen will regularly check the calico scallop beds that are within Site C. Shrimp trawl nets are used to check for calico scallops which are found from 9 to 366 m (30 to 1,200 ft).

Calico scallops have been landed in North Carolina in only five years since 1974. Calico scallop abundances are highly variable and catches can be lucrative when scallops are abundant. Calico scallops have not been landed in North Carolina since 1990, when they earned $530,590. In 1988 landings peaked at $702,134.

Pink shrimp are also caught in the Site C USWTR area. They are most abundant in depths between 11 and 37 m (36 and 121 ft), but can occur as deep as 65 m (213 ft) (SAFMC, 1996). As of this writing, pink shrimp are not in a high abundance in Site C. Rock shrimp are also found in small quantities off of North Carolina. They typically occur in depths between 35 and 55 m (115 and 180 ft) (FFWCC, 2005a). Rock shrimp were last landed in North Carolina in 1998 when a total of 2,544 kg (1,154 lbs) brought $1,154 (NMFS, 2006h).

Royal red shrimp, a deep-water shrimp, have not been landed in North Carolina, at least in the last 50 years, according to NMFS records (NMFS, 2006h). However, royal red shrimp have been landed in states north of Cape Hatteras and could have been caught off of North Carolina. Royal reds are primarily caught in Florida, however, abundance is highly variable and in some years royal red shrimp can be caught further north. Royal reds are fished at depths up to 421 m (1,381 ft).

Shrimp and calico scallop abundances are known to fluctuate and it can be expected that shrimp and calico scallop fisheries will occur in the Site C USWTR area over the lifetime of the range. Fishing effort could be heavily increased in the range area during years of calico scallop or shrimp abundance.

The snapper-grouper fishery is very important to the counties of Onslow Bay (Figure 3.4-2). Snapper-grouper fishermen fish in waters over Site C, between 91 and 183 m (300 and 600 ft), on the edge of the continental shelf 64 to 97 km (35 to 52 NM) from the coast of Onslow Bay. Snapper-grouper fishermen fish with bottom longlines, hook-and-line gear, and hydraulic reels. Fishermen target rocky areas which are plentiful in Site C. The snapper-grouper fishery was in decline in the first half of the decade from 1994 to 2004, but plateaued in the latter half (NCDMF, 2005b). Figure 3.4-7 presents data separated by taxonomic groups of the snapper-grouper complex.

The Navy evaluated available information on the use of fishing gear types within the four USWTR sites and spatially interpolated the estimated areas of gear use in a geographic information system (GIS). A ratio of the area of gear use within the range site and the total area of gear use off a state's coastline was calculated for each USWTR site. This ratio was calculated for each gear type and represents the estimated percent of fishing grounds for each gear type within Site C compared to the extent of the total grounds for each gear type off the coastline of North Carolina (Table 3.4-13). A caveat to this analysis is that it does not take into account areas of fishing concentration.

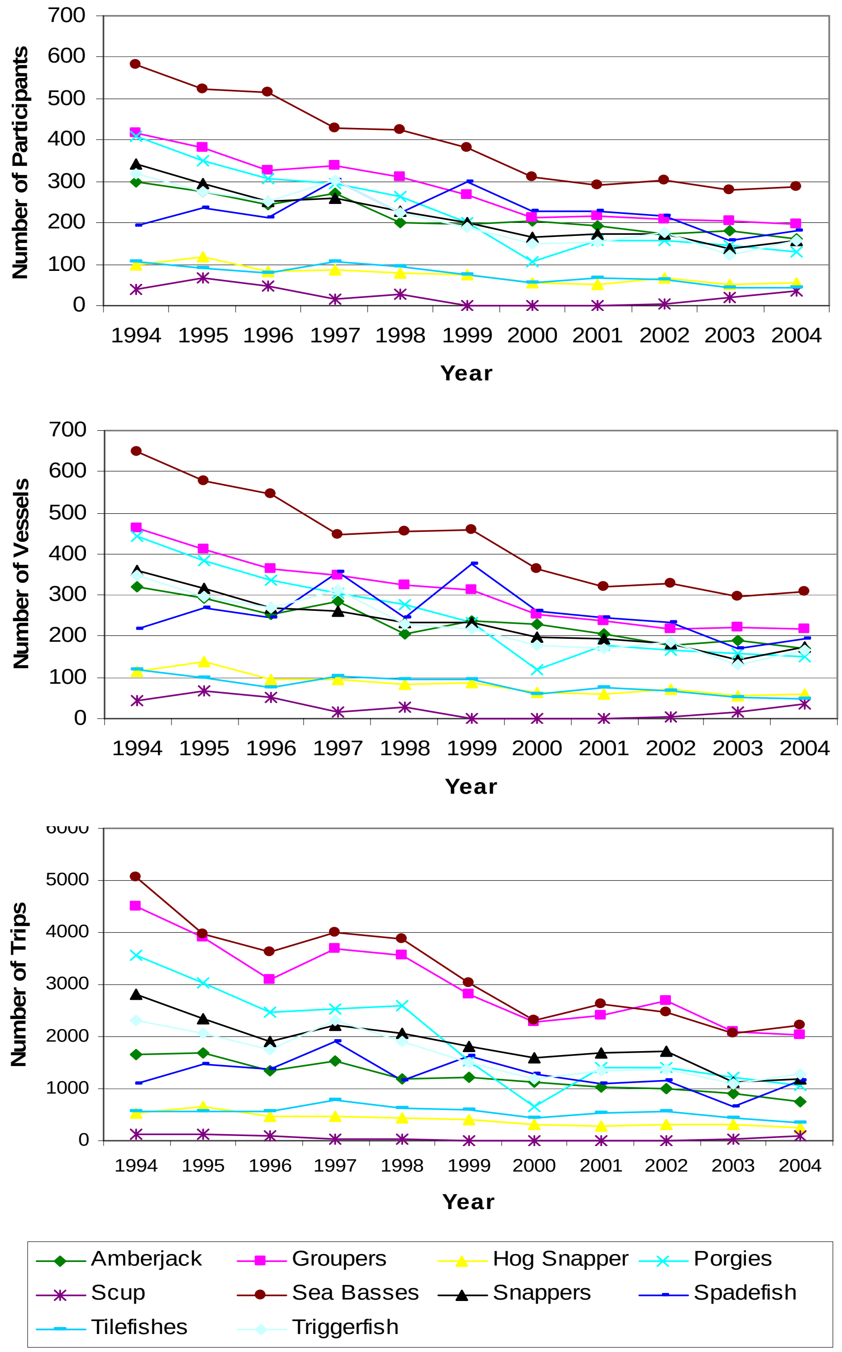


Figure 3.4-7

Number of North Carolina Commercial Fishing Participants, Vessels, and Trips for Snapper-Grouper Complex Taxonomic Groups from 1994 to 2004

Table 3.4-16

Geographical Overlap of Fishing Grounds
Within Site C

Gear Type	Percentage Overlap
Bottom long line for reef fish	11
Bottom long line for shark	4
Bottom trawl for calico scallops	8
Bottom trawl for rock shrimp	12
Hand line for snapper-grouper	8
Offshore trolling	8
Pelagic long line for fish	2
Pelagic long line for shark	3
Pots and traps	3

The most common gear used in Site C is bottom long line, handline and offshore trolling. While the range site occupies approximately eight percent of the calico scallop trawling grounds, calico scallops have not been landed in North Carolina since 1990. Similarly, rock shrimp have not been landed in North Carolina since 1998. Thus, the trawling gear used in these two fisheries is likely not often used in the range area, although it may occasionally be used to check for species abundance and commercial fishing viability.

3.4.2.4 Site D

The USWTR site in the VACAPES OPAREA is located off the coasts of both Maryland and Virginia; therefore fisheries in both states are described here. Fishery resources on the continental shelf offshore of Maryland and Virginia in the VACAPES OPAREA include several pelagic and demersal finfish, mollusks, and crustaceans (DoN, 1995b). Commercial fishing activity on these resources include sink gillnets and bottom trawls used principally on demersal finfish; dredges employed to harvest mollusks; purse seines, mid-ocean trawls, driftnets, and longlines used on pelagic resources; and traps employed on demersal finfish and crustaceans.

The majority of the commercial fishing grounds within the VACAPES OPAREA are found over the continental shelf, especially in the northern portion of the OPAREA, or near areas of relief or bottom structure (DoN, 2008m). The commercial fishing grounds are similar to those used by recreational fishermen (DoN, 2008m). Figure 3.4-8 depicts popular fishing areas and their relative locations to the proposed Site D USWTR. There are seven charted popular fishing areas

Popular Fishing Areas in the VACAPES OPAREA & Vicinity

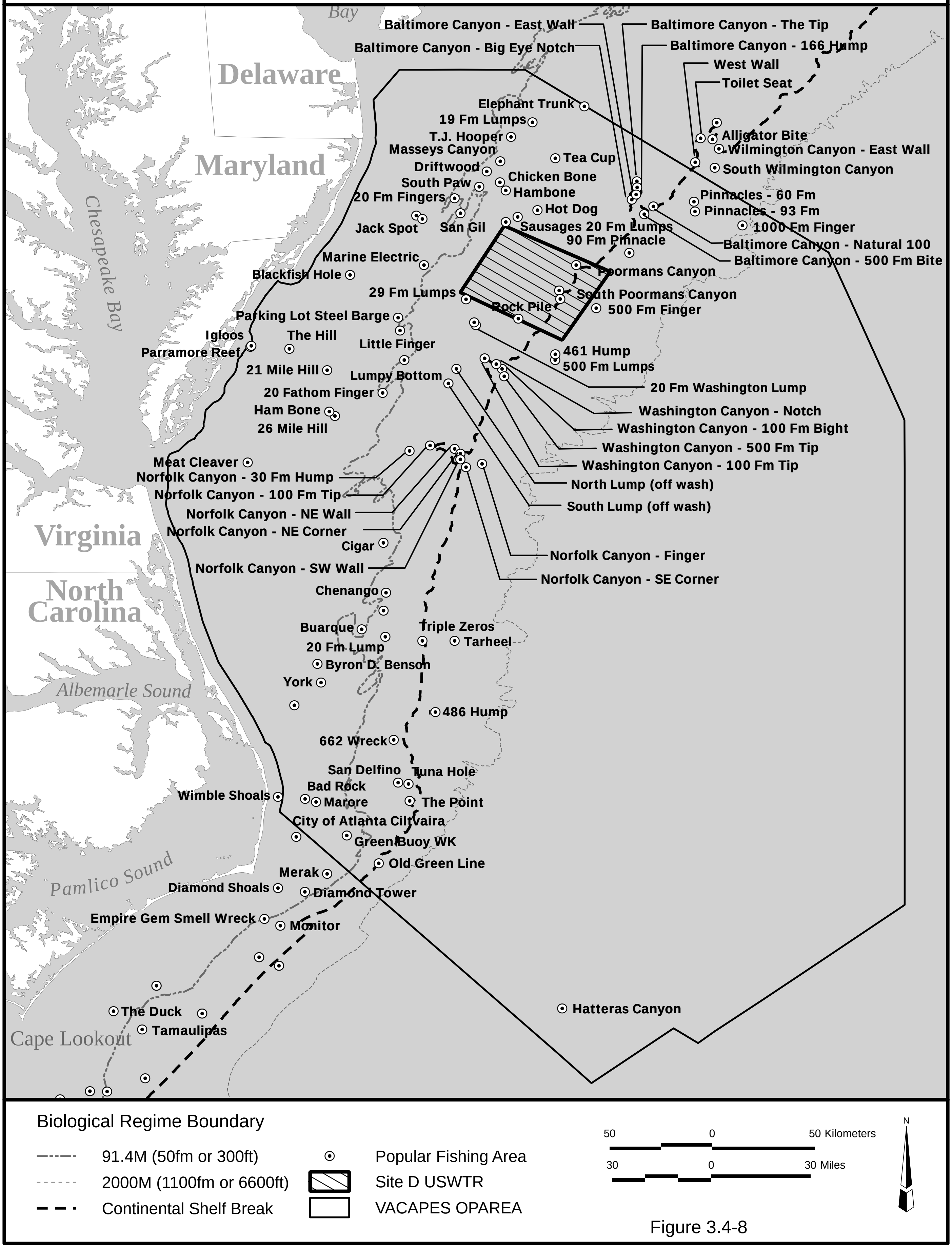


Figure 3.4-8

within the proposed Site D USWTR, including Poormans Canyon, South Poormans Canyon, 29 Fathom Lumps, Rock Pile, and 20 Fathom Washington Lump (Figure 3.4-8).

State Landings

NMFS landings data for Maryland and Virginia coastal and offshore waters were evaluated to determine the magnitude and value of the commercial marine fisheries. The most recent commercial fishing information available from NMFS for Maryland and Virginia was for the year 2006 (NMFS, 2007b). Detailed county economic information was not available for Maryland or Virginia as it was for North Carolina (see Subchapter 3.4.2.3).

Virginia

Between 1997 and 2006, the commercial landings of food and baitfish in Virginia, measured by weight, averaged over 221 million kg (488 million lbs). Commercial landings peaked in 1998 at nearly 269 million kg (593 million lbs), while the lowest landings occurred in 2006, when about 193 million kg (426 million lbs) of finfish and shellfish were landed.

Harvests remained moderately stable over the decade, with annual landings typically having deviated from the average by 13 percent. The landings data show a marked overall declining trend of approximately 23 percent over the ten years.

The dollar values of the landings averaged nearly $124 million over the ten-year period. Total values ranged from a low of nearly $101 million in 1997 to a high of over $160 million in 2004. Whereas landings by weight decreased at a rate of approximately 23 percent over the ten years, landings by value showed an increasing trend approaching 37 percent.

Similar to North Carolina (Site C), marine finfish and shellfish landings in Virginia are seasonal. However, the seasonality is more pronounced in the Virginia fisheries. In terms of landings by month, with over 39 percent of total landings by weight, July and August were the peak months in Virginia during 2006. High landings were also reported for June and September, with an additional 24 percent of total landings. Lowest landings by weight were reported for January and February, with a combined total of less than 1 percent of the 2006 landings. The highest landings by value were reported in April and May, when nearly 26 percent of the value of the catch was landed, while the lowest landing by value were reported in December and January, with approximately 6 percent of the landings by value of the catch.

Between 1997 and 2006, more than 95 percent of the commercial landings in Virginia, measured by value, were attributed to ten species of finfish and shellfish (Table 3.4-17). Over the ten-year period, annual commercial landings for these ten principal species averaged approximately $118 million.

Table 3.4-17

1997-2006 Average Annual Landings of 10 Principal Species – Virginia

Species	Landings by Value Thousand $	Percentage of Total Landings
10 Principal Species	118,050	95.2
Sea scallop	51,049	41.2
Menhaden	27,072	21.8
Blue crab	22,852	18.4
Atlantic croaker	3,761	3.0
Summer flounder	3,750	3.0
Striped bass	3,158	2.5
Quahog clam	2,294	1.9
Spot	1,681	1.4
Black sea bass	1,235	1.0
Snails (conchs)	1,198	1.0
Other Species	5,925	4.8
Total – All Species	123,974	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Sea scallop was the dominant species by value in Virginia, and menhaden was the second most dominant species. With average landings of over $51 million, sea scallops comprised over 41 percent of the landings. Menhaden comprised nearly 22 percent of the average landings, with average landings of over $27 million. The eight other principal species accounted for over 32 percent of the total landings.

By weight, about 49 percent of the landings in Virginia in 2006 were from state waters; approximately 51 percent were from federal waters (Table 3.4-18). By value, landings from state waters accounted for nearly 35 percent of the total value of the Virginia marine fisheries, whereas landings from federal waters amounted to over 65 percent.

In 2006, finfish dominated the catch measured by weight in Virginia state waters, representing approximately 89 percent of the catch. Shellfish comprised just 11 percent of the catch. In terms of value, however, finfish accounted for nearly 60 percent and shellfish comprised over 40 percent of the total value of the landings in Virginia state waters.

Table 3.4-18

2006 Commercial Landings by Distance – Virginia

	Landings by Weight				Landings by Value		
	Thousands of Kilograms	Thousands of Pounds	% of Area Landings	% of Total Landings	Thousands of Dollars	% of Area Landings	% of Total Landings
State Waters							
Finfish	83,347	183,745	88.7	43.1	22,961	59.8	20.9
Shellfish	10,653	23,486	11.3	5.5	15,452	40.2	14.0
Total	94,000	207,231	100.0	48.6	38,413	100.0	34.9
Exclusive Economic Zone							
Finfish	95,139	209,741	95.8	49.2	18,406	25.7	16.7
Shellfish	4,194	9,245	4.2	2.2	53,205	74.3	48.4
Total	99,332	218,986	100.0	51.4	71,611	100.0	65.1
Grand Total	193,332	426,217		100.0	110,024		100.0

Notes: Numbers may not total exactly due to rounding.
No landings from the high seas were reported.
Source: NMFS, 2007b.

Although the majority of the catch in federal waters, by weight, was finfish, shellfish accounted for a larger share of the value of the Virginia commercial fishery landings. By weight, nearly 96 percent of the landings from federal waters were finfish, and over 4 percent were shellfish. However, when measured by value, shellfish accounted for approximately 74 percent of the total landings from federal waters.

Maryland

Between 1997 and 2006, the commercial landings of food and baitfish in Maryland, measured by weight, averaged about 26 million kg (58 million lbs). Commercial landings peaked in 1997 at approximately 35 million kg (76 million lbs), while the lowest landings occurred in 2000, when about 22 million kg (49 million lbs) of finfish and shellfish were landed.

Harvests were variable over the decade, with annual landings typically having deviated from the average by about 16 percent. The landings data show a marked overall declining trend of approximately 19 percent over the ten years.

The dollar values of the landings averaged approximately $56 million over the ten-year period. Total values ranged from a low of about $49 million in 2002 to a high of approximately $64 million in 1997. Landings by value decreased at a rate of over 12 percent over the ten years.

Marine finfish and shellfish landings in Maryland are seasonal. In terms of landings by month, with 28 percent of total landings by weight, September and October were the peak months in Maryland during 2006. Lowest landings by weight were reported for January and December, with a combined total of about 5 percent of the 2006 landings. The highest landings by value were reported in June and July, when 30 percent of the value of the annual catch was landed, while the lowest landing by value were reported in January and December, with approximately 7 percent of the catch.

Between 1997 and 2006, approximately 93 percent of the commercial landings in Maryland, measured by value, were attributed to ten species of finfish and shellfish (Table 3.4-19). Over the ten-year period, landings for these ten principal species averaged nearly $52 million in annual commercial landings.

Table 3.4-19

1997-2006 Average Annual Landings of 10 Principal Species – Maryland

Species	Landings by Value Thousand $	Percentage of Total Landings
10 Principal Species	51,793	92.6
Blue crab	35,731	63.9
Clams or bivalves	4,375	7.8
Eastern oyster	3,797	6.8
Striped bass	3,673	6.6
Sea scallop	1,149	2.1
White perch	715	1.3
Softshell clam	714	1.3
Catfishes and bullheads	551	1.0
Atlantic croaker	550	1.0
Menhaden	539	1.0
Other Species	4,128	7.4
Total – All Species	55,921	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Blue crab was the dominant species by value in Maryland, and clams or bivalves were the second most dominant species/group. With average landings of approximately $36 million, blue crab comprised nearly 64 percent of the landings. Clams or bivalves comprised nearly 8 percent of the landings, with average landings of over $4 million. The eight other principal species accounted for nearly 21 percent of the total landings.

By weight, about 82 percent of the landings in Maryland in 2006 were from state waters; approximately 18 percent were from federal waters (Table 3.4-20). By value, landings from state waters accounted for 76 percent of the total value of the Maryland marine fisheries, whereas landings from federal waters amounted to 24 percent.

Table 3.4-20

2006 Commercial Landings by Distance – Maryland

	Landings by Weight				Landings by Value		
	Thousands of Kilograms	**Thousands of Pounds**	**% of Area Landings**	**% of Total Landings**	**Thousands of Dollars**	**% of Area Landings**	**% of Total Landings**
State Waters							
Finfish	5,211	11,487	27.5	22.4	7,925	19.5	14.8
Shellfish	13,750	30,312	72.5	59.2	32,784	80.5	61.2
Total	18,960	41,799	100.0	81.6	40,709	100.0	76.0
Exclusive Economic Zone							
Finfish	488	1,076	11.4	2.1	1,867	14.5	3.5
Shellfish	3,783	8,341	88.6	16.3	10,969	85.5	20.5
Total	4,272	9,417	100.0	18.4	12,836	100.0	24.0
Grand Total	23,232	51,216		100.0	53,545		100.0

Notes: Numbers may not total exactly due to rounding.
No landings from the high seas were reported.
Source: NMFS, 2007b.

In 2006, shellfish dominated the catch measured by weight in Maryland state waters, representing approximately 72 percent of the catch. Finfish comprised just 28 percent of the catch. In terms of value, shellfish accounted for approximately 80 percent and finfish comprised about 20 percent of the total value of the landings in state waters.

The majority of the catch in federal waters, by weight and by value, was shellfish. By weight, approximately 89 percent of the landings from federal waters were shellfish, and about 11 percent were finfish. When measured by value, shellfish accounted for approximately 86 percent of the total landings from federal waters.

Fishing Gear and Fishing Effort

Virginia

The principal commercial gears used to harvest the marine fishery resources of Virginia are dredges, purse seines, and pots and traps (Table 3.4-21). Most fish and shellfish landed in Virginia, as measured by value, were captured using dredges, with over 38 percent of the fish and shellfish landed in the state having been captured by dredges. Approximately 21 percent of the landed fish and shellfish were captured using purse seines, and pots and traps captured over 18 percent.

Table 3.4-21

1997-2006 Average Annual Commercial Landings by Gear Type – Virginia

Gear Type	Landings by Value Thousand $	Percentage of Total Landings
Dredge	47,446	38.3
Purse seines	26,382	21.3
Pots and traps	22,653	18.3
Otter trawl bottom	10,644	8.6
Gill nets	7,499	6.0
Pound nets	4,103	3.3
Tongs, grabs, picks, scrapes and rakes	2,765	2.2
Haul seines	1,075	0.9
Hand lines	654	0.5
By hand	133	0.1
Long lines	108	0.1
Other gear types	513	0.4
Total – All Gear	123,973	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Maryland

The principal commercial gears used to harvest the marine fishery resources of Maryland are pots and traps, and lines trot with bait (Table 3.4-22). The majority of fish and shellfish landed in Maryland, as measured by value, were captured using pots and traps, with nearly 37 percent of the fish and shellfish landed in the state having been captured by pots and traps. Nearly 14 percent of the landed fish and shellfish were captured using lines trot with bait.

Table 3.4-22

1997-2006 Average Annual Commercial Landings by Gear Type – Maryland

Gear Type	Landings by Value Thousand $	Percentage of Total Landings
Pots and traps	20,641	36.9
Lines trot with baits	7,704	13.8
Dredge	6,644	11.9
Pound nets	3,058	5.5
Gill nets	2,297	4.1
Tongs, grabs, picks, scrapes and rakes	2,295	4.1
Otter trawl bottom	973	1.7
Hand lines	688	1.2
Diving outfits	511	0.9
Long lines	343	0.6
Fyke and hoop nets	342	0.6
Haul seines	88	0.2
Other gear types	10,336	18.5
Total – All Gear	55,921	100.0

Notes: Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

Fisheries Within Range Site D

Table 3.4-23 presents the geographical overlap of the fishing grounds within Site D compared to the extent of the grounds off the coastlines of Maryland and Virginia. Several fishing methods occur in the shallow waters of Site D. Fishing methods occurring over much of the Site D area include bottom otter trawling (from 5.6 km [3 NM] from shore to about a water depth of 366 m [1,200 ft]), pelagic longlining (from 37 m to 91 m [121 ft to 300 ft]), bottom longlining (91 m to 273 m [300 ft to 896 ft]), gillnetting (0 m to 40 m [0 ft to 131 ft]), and hook-and-line fishing (0 m to 200 m [0 ft to 656 ft]). However, purse seining, one of the most popular methods of fishing in Maryland and Virginia, only occurs in depths to 20 m (66 ft) and the fishing area does not overlap Site D.

Table 3.4-23

2000-2004 Geographical Overlap of Fishing Grounds
within Site D

Gear Type	Percentage Overlap
Bottom long line for shark	7
Bottom otter trawl for longfin squid	21
Bottom otter trawl for shortfin squid	22
Bottom otter trawling	7
Dredging for clams and scallops	6
Drift gill net	6
Hand line for reef fish	22
Pelagic long line	7
Pots and traps	6
Sink gill net	7

Sea scallops are fished with scallop dredges out to about 55 m (180 ft) but generally not past 91 m (300 ft). The mid-Atlantic is a very productive scalloping ground. Thirty-two percent of all sea scallops caught in the United States was caught in the mid-Atlantic in 2004 (NMFS, 2007b). There is overlap with some of the sea scallop fishing areas and Site D. Sea scallop landings have increased a substantial amount in the past ten years. In 1997, sea scallop landings in the United States were valued at $89 million. By 2006, landings had increased to $386 million.

The area of anchored gillnet fishing for monkfish (goosefish) also overlaps Site D in the shallow waters of the range (to 100 m [330 ft]). Site D is a very common area for this fishery. Also in the shallow area of Site D, hydraulic dredges are used to fish ocean quahogs (to 91 m [300 ft]) and surfclam (to 18 m [60 ft]). Pots and traps also make up a sizable percentage of the landings in Maryland and Virginia and are fished in the shallow (as deep as 91 m [300 ft]) areas of the proposed range site.

3.4.3 Recreational Fishing

Recreational fishing is popular along the eastern seaboard of the United States. In 2006, Florida, North Carolina, and Maryland were ranked as the top three states where most anglers in the United States fished, and Virginia and South Carolina ranked seventh and eighth, respectively (NMFS, 2007b). Florida was the top state in 2006 for fishing by resident anglers. North Carolina, Maryland, Virginia, and South Carolina ranked third, fourth, eighth and tenth, respectively (NMFS, 2007b). Florida, North Carolina, and South Carolina were the top three states in 2006 for fishing by out-of-state anglers, while Maryland and Virginia ranked sixth and seventh, respectively (NMFS, 2007b). The top two states with the highest number of out-of-state anglers compared to in-state anglers in 2006 were Rhode Island and South Carolina. North Carolina ranked third, Florida seventh, Maryland eleventh, and Virginia twelfth, (NMFS, 2007b). Florida and North Carolina were the top ranking states in 2006 for the number of trips taken in ocean (non-inland) waters. South Carolina, Virginia, and Maryland ranked sixth, tenth, and thirteenth, respectively (NMFS, 2007b).

While recreational fishing is popular in each of the OPAREAs, most recreational fishing and boating occurs within a few miles of shore and is expected to be relatively infrequent in the vicinity of any of the proposed USWTR sites. Table 3.4-24 presents the average annual recreational fishing trips in the state territorial sea and in the federal exclusive economic zone. Between 1997 and 2006, approximately 80 percent of recreational fishing trips in the ocean waters off the east coast of Florida, and the coasts of Georgia, South Carolina, North Carolina, Virginia, and Maryland were trips to the state territorial waters, whereas only about 20 percent were trips to the exclusive economic zone.

Table 3.4-24

1997-2006 Average Annual Recreational Fishing Trips

State	Trips			Percentage of Ocean[1] Trips		
	State Territorial Sea	Exclusive Economic Zone	Ocean[1]	State Territorial Sea	Exclusive Economic Zone	Ocean[1]
East Florida	4,194,457	1,544,678	5,739,135	73.1	26.9	100.0
Georgia	147,645	33,406	181,052	81.5	18.5	100.0
South Carolina	955,163	116,651	1,071,814	89.1	10.9	100.0
North Carolina	3,901,722	526,434	4,428,156	88.1	11.9	100.0
Virginia	487,465	184,786	672,250	72.5	27.5	100.0
Maryland	189,033	110,739	299,772	63.1	36.9	100.0
Total	9,875,485	2,516,693	12,392,178	79.7	20.3	100.0

Note: [1]Ocean is state territorial sea and federal exclusive economic zone combined.
Source: NMFS, 2009i.

3.4.3.1 Site A

Recreational fishing is an important industry along the east coast of Florida. In 2006, Marine Recreational Fishery Statistics Surveys (MRFSS) field personnel identified 241 species of marine fish landed along the east coast of Florida (NMFS, 2007b). Also in 2006, roughly half of the saltwater fishing trips were taken on private, rental, charter, and party/head boats, with the remainder taken from shore (NMFS, 2007b). Popular fishing areas and their relative locations to the proposed Site A USWTR are shown in Figure 3.4-2. Five charted popular fishing areas are located within the proposed Site A.

Both private and charter recreational bottom fishing vessels target hard bottom and artificial reefs. Artificial reefs can be constructed from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities (see Figure 3.5-1). There are no artificial reefs in the range area, but there are currently 106 artificial reef complexes in the corridor area (FFWCC, 2005b). There has been active artificial reef development off the City of Jacksonville for over 40 years and the City of Jacksonville has been permitted 21 areas offshore of Jacksonville for the construction and placement of artificial reefs by the USACE (Morton, 2008). Artificial reefs are very popular for both bottom fishing and sport diving. These areas receive high amounts of vessel traffic. Hard bottom habitat is described in Subchapter 3.2.4. Hard bottom habitat and other bottom features provide many “lesser-known” fishing locations that are not charted on the popular fishing areas as shown in Figure 3.4-2.

Recreational fishermen also target pelagic species offshore of Florida such as tuna, mackerel, dolphinfish, wahoo, cobia, and billfish. Pelagic fish can be associated with bottom features (see popular fishing areas in Figure 3.4-2) or with oceanographic features. The western front of the Gulf Stream, as well as eddies that regularly break away from the Gulf Stream, offer distinct oceanographic habitats where a number of these species congregate and are targeted by fishermen. The west front of the Gulf Stream would be present within the Site A USWTR most of the year. Eddies breaking off the Gulf Stream could be present sporadically during some years, but can persist for months when present. 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; fishermen will target these *Sargassum* mats.

The MRFSS conducted by NMFS provide estimates of fishing effort, catch, and participation by recreational anglers in the marine waters of the U.S. The following discussion of recreational fishing along the east coast of Florida is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for Florida from NMFS was for the year 2006.

State Landings

Eastern Florida

Over the decade from 1997 through 2006, the recreational landings of finfish caught in state and federal waters along the east coast of Florida averaged approximately 9 million kg (19 million lbs). Recreational landings ranged from a high of over 10 million kg (23 million lbs) in 2000 to a low of about 7 million kg (15 million lbs) in 2005.

Federal landings over the decade showed an increase until 2000 with nearly 6 million kg (14 million lbs) and were in slight decline over the remainder of the decade, with a low in 2005 of 3 million kg (6 million lbs). In 2006, however, an increase of 5 million kg (10 million lbs) occurred.

Data from the MRFSS database were used to characterize the composition of recreational landings of finfish caught in federal waters over the decade from 1997 to 2006. Two species groups accounted for 69 percent of the recreational landings by weight. Dolphinfish was the most important species group, in terms of recreational landings by weight, accounting for over 38 percent of the total recreational landings from federal waters off the east coast of Florida. Dolphinfish landings peaked in 2001 with 2.6 million kg (5.7 million lbs). The decade's low dolphinfish landings occurred in 2005 with 1.2 million kg (2.7 million lbs). Tunas and mackerels comprised the second-ranked group, accounting for over 24 percent of the total landings by weight. Highest landings of tunas and mackerels occurred in 1999 with 1.9 million kg (4.3 million lbs). Lowest landings occurred in 2005 with 0.7 million kg (1.4 million lbs).

Georgia

Marine recreational landings for Georgia, by weight, averaged approximately 223,000 kg (492,000 lbs) during the 1997 to 2007 decade. Recreational landings in Georgia were at a decade low in 2002, at approximately 74,000 kg (164,000 lbs). The peak annual recreational landing figure for the decade was nearly 325,000 kg (716,000 lbs), recorded two years earlier, in 2000.

In federal waters, landings in 2002 were the decade's lowest at approximately 32,000 kg (70,000 lbs). Landings in federal waters over the decade peaked the next year, in 2003, with about 229,000 kg (506,000 lbs) – over seven times greater than the weight of the landings of the previous year. In terms of landings by weight in Georgia, tunas and mackerels comprised the first-ranked species group over the decade in the federal waters recreational fishery. Tunas and mackerels accounted for nearly 29 percent of the total recreational landings from federal waters landed in Georgia. Tunas and mackerels landings peaked in 2000 with approximately 127,000 kg (279,000 lbs). Landings were lowest six years later, in 2003, with less than 8,000 kg (17,000 lbs). Other high ranking species groups over the decade were sea basses (22 percent) and snappers (12 percent).

Fishing Effort

Eastern Florida

About 1,570,000 fishing trips were taken in 2006 by individual marine recreational anglers fishing in the federal waters along the east coast of Florida (Table 3.4-25). The estimated number of participants in recreational fishing in marine fishing areas of eastern Florida, including the state territorial sea and federal waters, was nearly 5 million persons.

The were fewer seasonal variations in recreational fishing effort, in terms of trips and number of participants, along the east coast of Florida than in the waters of South Carolina, North Carolina, Maryland, or Virginia. Unlike the other states, Florida shows substantial activity during the winter months and generally stable recreational fishing effort throughout the year. For effort measured in terms of trips to federal waters in 2006, effort peaked during the six-month period from March through August, when just over 60 percent of the annual trips were taken.

Table 3.4-25

2006 Recreational Fishing Effort – Florida East Coast

Months	Trips		Participants	
	Number	Percentage	Number	Percentage
January – February	125,456	8.0	743,169	15.0
March – April	325,203	20.7	962,948	19.5
May – June	445,163	28.3	1,047,177	21.2
July – August	332,270	21.2	970,598	19.6
September – October	203,244	12.9	593,399	12.0
November – December	139,153	8.9	631,348	12.8
TOTAL	1,570,489	100.0	4,948,639	100.0

Notes: Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Georgia

Approximately 33,000 fishing trips were taken in 2006 by individual recreational anglers fishing in federal waters off the coast of Georgia (Table 3.4-26). According to MRFSS estimates, nearly 339,000 persons participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters.

In 2006, recreational fishing effort, in terms of trips and number of participants, was concentrated in the period from March through August. Over 78 percent of the reported trips were taken during this six-month period of 2006. Participation during these months was over 74 percent of the year's reported total.

Table 3.4-26

2006 Recreational Fishing Effort – Georgia

Months	Trips		Participants	
	Number	Percentage	Number	Percentage
January – February	0	0.0	0	0.0
March – April	5,763	17.6	71,108	21.0
May – June	13,786	42.2	100,062	29.5
July – August	5,972	18.3	79,744	23.5
September – October	6,542	20.0	50,279	14.8
November – December	620	1.9	37,640	11.1
TOTAL	32,683	100.0	338,833	100.0

Notes: Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2009i.

Fishing Tournaments

Organized fishing tournaments, targeting a single species or multiple species, are popular in Florida. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in Florida occur between mid-May and late July.

3.4.3.2 Site B

In 2006, MRFSS field personnel identified 109 species of marine fish landed in South Carolina (NMFS, 2007b). Also in 2006, roughly one-quarter of the saltwater fishing trips were taken on private, rental, charter, and party/head boats, with the remainder taken from shore (NMFS, 2007b). Popular fishing areas and their relative locations to the proposed Site B USWTR are shown in Figure 3.4-3. Ten charted popular fishing areas are located within the proposed Site B.

Both private and charter recreational bottom fishing vessels target hard bottom and artificial reefs. Artificial reefs can be constructed from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities. Artificial reefs are very popular for both bottom fishing and sport diving. These areas receive high amounts of vessel traffic, particularly in the summer months. Hard bottom habitat is described in Subchapter 3.2.4. Hard bottom habitat and other bottom features provide many “lesser-known” fishing locations that are not charted on the popular fishing areas as shown in Figure 3.4-3.

Recreational fishermen also target pelagic species offshore of South Carolina, such as tuna, mackerel, dolphinfish, wahoo, cobia, and billfish. Pelagic fish can be associated with bottom features (see popular fishing areas in Figure 3.4-3) or with oceanographic features. South Carolina’s offshore features serve to support and sustain many resident and migratory fisheries species. Structural features on the continental shelf include natural hard bottoms, as well as artificial reefs and shipwrecks. No artificial reefs and 1 major shipwreck occur within the proposed Site B USWTR, and 13 artificial reefs and 30 major shipwrecks occur within the proposed trunk cable corridor.

The Charleston Bump, a unique habitat located southeast of Charleston on the Blake Plateau, deflects the Gulf Stream offshore in the South Atlantic Bight, resulting in ocean upwelling that brings nutrients to the surface waters. This increases the primary productivity of South Carolina’s coastal ocean waters, supporting and concentrating a food chain from zooplankton to small fish to commercially and recreationally important reef and pelagic fish that prey on them (South Carolina Sea Grant, 2007). Additionally, 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 B USWTR during all parts of the year; fishermen will target these *Sargassum* mats.

The following discussion of recreational fishing in South Carolina is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for South Carolina from NMFS was for the year 2006.

State Landings

Over the decade from 1997 to 2006, the recreational landings of finfish caught in state and federal waters off of South Carolina averaged approximately 1.0 million kg (2.2 million lbs). Recreational landings ranged from a high of over 1.4 million kg (3 million lbs) in 1997 to a low of about 0.5 million kg (1.2 million lbs) in 2002. Federal landings were variable. In 2001, a high occurred of 0.6 million kg (1.4 million lbs) while a low occurred just a year later, in 2002, of 0.3 million kg (0.6 million lbs).

Data from the MRFSS database were used to characterize the composition of recreational landings of finfish caught in federal waters during the decade from 1997 to 2006. Three species groups accounted for 71 percent of the recreational landings by weight. Tunas and mackerels comprise the most important species group in terms of recreational landings by weight, accounting for over 40 percent of the total recreational landings from federal waters off of South Carolina. Landings of tunas and mackerels declined over the decade. Landings peaked in 1997 with 0.36 million kg (0.80 million lbs) and reached a low in 2005 with 0.07 million kg (0.16

million lbs). Sea bass comprised the second-ranked group, accounting for over 15 percent of the total landings by weight. Dolphinfish were the third-ranked group, also with approximately 15 percent of the landings.

Fishing Effort

About 147,000 fishing trips were taken in 2006 by individual marine recreational anglers fishing in the federal waters off of the coast of South Carolina (Table 3.4-27). In 2006, the estimated number of participants in recreational fishing in marine fishing areas off of South Carolina, including state territorial sea and federal waters, was nearly 1.5 million persons.

Table 3.4-27

2006 Recreational Fishing Effort – South Carolina

Months	Trips		Participants	
	Number	Percentage	Number	Percentage
March - April	14,161	9.6	91,800	6.4
May - June	57,961	39.4	367,988	25.8
July - August	37,281	25.4	355,766	24.9
September - October	24,703	16.8	395,568	27.7
November - December	12,952	8.8	216,577	15.2
TOTAL	147,058	100.0	1,427,699	100.0

Notes: No trips or participants were reported for the January – February period.
Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Recreational fishing effort off of South Carolina is seasonal. In 2006, no trips or participants were reported for the January through February time frame and few trips or participants (9.6 percent and 6.4 percent, respectively) were reported March through April. Eighty-two percent of the year's trips and 78 percent of the year's participation occurred in the six-month period from May through October.

Fishing Tournaments

Organized fishing tournaments, targeting a single species or multiple species, are popular in South Carolina. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in South Carolina occur between mid-April and early September.

3.4.3.3 Site C

Marine recreational fishing in North Carolina is a substantial industry with a high level of activity. Several unique factors in the Cherry Point OPAREA heighten recreational fishing opportunities. One is the proximity of the continental shelf break, which is only 41 km (22 NM) from Cape Hatteras. Another is the location and behavior of the Gulf Stream, which is relatively close to shore along southern North Carolina before turning out to sea at Cape Hatteras. In 2006, MRFSS field personnel identified 152 species of marine fish landed in North Carolina (NMFS, 2007b). Also in 2006, roughly 60 percent of the saltwater fishing trips were taken on private, rental, charter, man made, and party/head boats, with the remainder taken from shore (NMFS, 2007b).

Recreational fishermen, including those participating in tournaments, focus their efforts in specific locations, especially when bottom-fishing. These popular fishing areas (Figure 3.4-4) are often associated with habitat features that concentrate fishes. Most popular fishing areas are located between shore and the shelf break; this is not surprising, given the limited range of many recreational fishing boats and the difficulty of fishing for demersal fishes in deep water beyond the shelf break. Ten popular fishing areas are located within the proposed Site C USWTR.

Both private and charter recreational bottom fishing vessels south of Cape Hatteras target hard bottom and artificial reefs. The state of North Carolina has constructed 21 artificial reefs in Onslow Bay from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities. The artificial reefs are very popular for both bottom fishing and sport diving. They are well marked by surface buoys and are displayed on navigational charts. These areas receive high amounts of vessel traffic, particularly in the summer months. No artificial reefs occur within the proposed Site C USWTR or within the proposed trunk cable corridor. Five major shipwrecks occur within the proposed Site C USWTR and ten major shipwrecks occur within the proposed trunk cable corridor. Hard bottom habitat (described in Section 3.2.4) and other bottom features provide many “lesser-known” fishing locations that are not charted on the popular fishing areas in Figure 3.4-4.

Recreational fishermen also target pelagic species offshore of North Carolina such as tuna, mackerel, dolphinfish, and billfish. Pelagic fish can be associated with bottom features (see popular fishing areas, Figure 3.4-4) or with oceanographic features. The western front of the Gulf Stream, as well as eddies that regularly break away from the Gulf Stream, offer distinct oceanographic habitats where a number of these species congregate and are targeted by fishermen. The west front of the Gulf Stream would be present within the Site C USWTR most of the year. Eddies breaking off the Gulf Stream could be present sporadically during some years, but can persist for months when present. 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.

The following discussion of recreational fishing off of North Carolina is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for North Carolina from NMFS was for the year 2006.

State Landings

During the decade from 1997 through 2006, the recreational landings of finfish caught in state and federal waters off the coast of North Carolina, measured by weight, averaged approximately 8 million kg (19 million lbs). Recreational landings ranged from a low of nearly 6 million kg (13 million lbs) in 1998 to a high of over 10 million kg (22 million lbs) eight years later, in 2006.

Data from the MRFSS database were used to characterize the composition of North Carolina recreational landings of finfish caught in federal waters during the decade from 1997 to 2006. Two species groups account for approximately 93 percent of the recreational landings by weight. Tunas and mackerels was the most important species group in terms of recreational landings by weight, accounting for 58 percent of the total recreational landings from federal waters off North Carolina. Tunas and mackerels averaged 3.7 million kg (8.1 million lbs) over the decade, reaching a low of 2.1 million kg (4.6 million lbs) in 2002 and a high of 4.6 million kg (10.3 million lbs) in 2000.

Dolphinfish (of genus *Coryphaena*) comprised the second-ranked group, approximately 35 percent of total recreational landings by weight from federal waters off North Carolina. Dolphinfish landings averaged 2.2 million kg (4.8 million lbs) over the decade, reaching a low of 1.3 million kg (3.0 million lbs) in 2004 and a high of 2.9 million kg (6.4 million lbs) in 2002.

Fishing Effort

Based on MRFSS estimates, individual marine recreational anglers fishing in the federal waters off the coast of North Carolina took approximately 712,457 fishing trips in 2006 (Table 3.4-28). The estimated number of participants in recreational fishing in marine fishing areas in 2006, including state territorial sea and federal waters, was more than 2.2 million persons.

In 2006, recreational fishing effort, in terms of trips and number of participants, was concentrated in the period from May through October. Over 80 percent of the annual effort, measured in the number of participants, occurred during this six-month period. The number of trips to federal waters peaked during the four months of May through August, when nearly 65 percent of the annual trips were taken.

Table 3.4-28

2006 Recreational Fishing Effort – North Carolina

Months	Trips		Participants	
	Number	Percentage	Number	Percentage
January – February	13,236	1.9	119,166	3.4
March – April	26,489	3.7	282,606	8.0
May – June	224,472	31.5	972,696	27.5
July – August	236,976	33.3	1,048,930	29.6
September – October	113,783	16.0	875,495	24.7
November – December	97,501	13.7	241,157	6.8
TOTAL	712,457	100.0	3,540,050	100.0

Notes: Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

Fishing Tournaments

Organized fishing tournaments, targeting a single species or multiple species, are popular in North Carolina. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in North Carolina occur between mid-May and early November. The greatest number of tournaments occurs in the summer months, from July through September, while no tournaments are typically scheduled during the winter months of December through early April (Coastal Guide, 2007; NCDMF, 2007).

3.4.3.4 Site D

Recreational fishing is a major industry in Maryland and Virginia. In 2006, MRFSS field personnel identified 41 species of marine fish landed in Maryland and 43 species landed in Virginia (NMFS, 2007b). Also in 2006, from each of these states, nearly 80 percent of the saltwater fishing trips were taken on private, rental, charter, and party/head boats, with the remainder taken from shore (NMFS, 2007b). As previously noted, the commercial fishing grounds are similar to those used by recreational fishermen and are shown in Figure 3.4-8. Seven charted popular fishing areas are located within the proposed Site D USWTR.

Bottom fishing vessels off of the Maryland and Virginia coasts target bottom structures and artificial reefs. Artificial reefs can be constructed from sunken ships, planes, railroad cars, and construction debris to enhance recreational fishing opportunities. Artificial reefs, shipwrecks, and other bottom features provide many “lesser-known” fishing locations that are not charted in the popular fishing areas shown on Figure 3.4-8.

Eight artificial reef sites lie within Delaware Bay and three artificial reef sites are offshore of Delaware within the VACAPES OPAREA, each associated with multiple reefs. The three artificial reef complexes within the VACAPES OPAREA corridor are all located south of Delaware Bay and are mainly comprised of recycled ballasted tires, concrete, construction equipment, and military vehicles (DNREC, 2005). The artificial reefs located nearshore primarily support blue mussels, (*Mytilus edulis*), black sea bass, scup, weakfish, bluefish, striped bass, and tautog (DNREC, 2005). No artificial reefs and 5 major shipwrecks occur within the proposed Site D USWTR, and 7 artificial reefs and 18 major shipwrecks occur within the proposed trunk cable corridor.

Recreational fishermen also target pelagic species such as tuna, dolphinfish, and mackerel offshore of Maryland and Virginia. Pelagic fish can be associated with bottom features (see popular fishing areas in Figure 3.4-8) or with oceanographic features. The eddies that regularly break away from the Gulf Stream offer distinct oceanographic habitats where a number of these pelagic game fish species congregate and are targeted by fishermen. Eddies breaking off the Gulf Stream could be present sporadically during some years, but can persist for months when present over the proposed Site D USWTR. 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 D USWTR during all parts of the year; fishermen will target these *Sargassum* mats.

The following discussion of recreational fishing off the coast of Maryland and Virginia is based on the findings of the MRFSS (NMFS, 2007b). The most recent available recreational fishing information for Virginia and Maryland from NMFS was for the year 2006 (NMFS, 2007b).

State Landings

Maryland

Marine recreational landings for Maryland, by weight, averaged approximately 1.0 million kg (2.0 million lbs) during the 1997 to 2006 decade. The peak annual recreational landings for the decade occurred in 1997 at over 1.3 million kg (2.9 million lbs). Recreational landings in Maryland were at a decade low in 2004 with 0.5 million kg (1.0 million lbs).

Landings in federal waters fluctuated with a high of 1.3 million kg (2.8 million lbs) in 1997 and a low of 0.4 million kg (0.9 million lbs) in 2004. Landings were highest in 1997 and 1998 and again in 2001 and 2002 with sharp declines (about half of the landings) in all other years.

In terms of landings by weight, tunas and mackerels comprised the first-ranked species group over the 1997 to 2006 decade in the federal waters recreational fishery off the coast of Maryland. Tunas and mackerels accounted for over 62 percent of the total recreational landings from federal waters landed in Maryland, with an average of 0.5 million kg (1.1 million lbs). Tunas and mackerels landings fluctuated over the decade ranging from a high of 1.0 million kg (2.2 million lbs) in 2001 to a low of 0.2 million kg (0.4 million lbs) in 2000. Other high ranking species groups were seabasses (13 percent), bluefish (10 percent), dolphinfish (5 percent), and cartilaginous fishes (3 percent).

Virginia

Marine recreational landings for Virginia, by weight, averaged approximately 1.6 million kg (3.5 million lbs) during the 1997 to 2007 decade. Recreational landings in Virginia were at a decade low in 2003, at less than 1.0 million kg (2.3 million lbs). The peak annual recreational landing figure for the decade was over 2.5 million kg (5.6 million lbs), recorded in 1997.

In federal waters, landings over the decade increased until they peaked in 2001 with 1.5 million kg (3.5 million lbs). After 2001, a sharp decline occurred throughout the remainder of the decade. Landings in 2006 were the decade’s lowest with 0.3 million kg (0.5 million lbs).

In terms of landings by weight, tuna and mackerel comprised the first-ranked species group during the decade from 1997 to 2006 in the federal waters recreational fishery off the coast of Virginia. Tunas and mackerels accounted for over 38 percent of the total recreational landings from federal waters landed in Virginia. Tunas and mackerels landings peaked in 2001 with approximately 0.95 million kg (2.10 million lbs). Landings were lowest in 2003 with 0.08 million kg (0.17 million lbs). Other high ranking species groups over the decade were sea basses (16 percent), ‘other fishes’ (14 percent), and drums (6 percent).

Fishing Effort

Maryland

Almost 73,000 fishing trips were taken in 2006 by individual recreational anglers fishing in federal waters off the coast of Maryland (Table 3.4-29). According to MRFSS estimates, nearly 2 million persons participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters (NMFS, 2007b).

Table 3.4-29

2006 Recreational Fishing Effort – Maryland

Months	Trips		Participants	
	Number	Percentage	Number	Percentage
March - April	689	0.9	272,938	13.3
May - June	21,718	29.8	573,288	27.8
July - August	35,610	48.9	646,026	31.4
September - October	13,682	18.8	382,624	18.6
November - December	1,174	1.6	183,693	8.9
TOTAL	72,873	100.0	2,058,569	100.0

Notes: No trips or participants were reported for the January – February period.
Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

In 2006, recreational fishing effort, in terms of trips, was concentrated in July and August with 49 percent of the trips occurring during these months. However, in terms of number of participants, fishing effort was more spread out over the period from May to October, with 78 percent of participants fishing during this time period.

Virginia

Approximately 119,000 fishing trips were taken in 2006 by individual recreational anglers fishing in federal waters off the coast of Virginia (Table 3.4-30). According to MRFSS estimates, nearly 2 million persons participated in recreational fishing in marine fishing areas, including the state territorial sea and federal waters off the coast of Virginia.

In 2006, recreational fishing effort, in terms of trips and number of participants, was concentrated in the period from May through August. Approximately 82 percent of the trips were taken during this four-month period of 2006. Participation during these months was 64 percent of the year’s total.

Fishing Tournaments

Organized fishing tournaments, targeting a single species or multiple species, are popular in Maryland and Virginia. The maximum distance usually traveled by offshore tournament participants is 139 km (75 NM) from the tournament host site. The sites fished by anglers within the tournament geographical boundaries are dependent on several factors including the species targeted, tournament rules, and weather. The level of participation varies between individual tournaments, seasons, and years. The major recreational fishing tournaments hosted in Maryland and Virginia occur between mid-June and late October. The greatest number of tournaments occurs in the summer months, from July through September.

Table 3.4-30

2006 Recreational Fishing Effort – Virginia

Months	Trips		Participants	
	Number	Percentage	Number	Percentage
March – April	8,383	7.0	233,688	11.8
May – June	48,431	40.7	665,624	33.6
July – August	48,833	41.0	594,000	30.0
September – October	6,930	5.8	246,027	12.4
November – December	6,564	5.5	242,450	12.2
TOTAL	119,141	100.0	1,981,789	100.0

Notes: No trips or participants were reported for the January – February period.
Reported trips are marine recreational fishing trips to federal waters only.
Reported participants are marine recreational anglers visiting any marine fishing areas, including the state territorial sea and federal waters.
Numbers may not total exactly due to rounding.
Source: NMFS, 2007b.

3.4.4 Commercial Shipping and Recreational Boating

3.4.4.1 Commercial Shipping

The waters off the U.S. Atlantic coast support a large volume of maritime traffic heading to and from 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 U.S. coast. Nearshore shipping lanes aid ocean-going vessels in avoiding navigational conflicts and collisions in areas leading into and out of major ports. Offshore, there are no designated shipping lanes; vessels generally follow routes determined by their destination, depth requirements, and the current weather conditions.

As stated in Chapter 2, shipping traffic data have been reexamined since previous versions of this document. A qualitative assessment based on an analysis of shipping densities by NAVOCEANO and a quantitative assessment based on analyses of ICOADS and AMVER data were utilized instead of HITS data because these databases were deemed to be more representative of actual shipping activity.

The report obtained from the NAVOCEANO (2007) plotted shipping data compiled over a five-year period and characterized areas of the ocean according to five density regimes (infrequent, light, moderate, heavy, very heavy). All of the proposed USWTR action alternative sites were in the "light" category (2-11 ships per day per 343 km^2 [100 NM^2]).

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 (see Figure 3.4-9).

3.4.4.2 Recreational Boating

Site A

Recreational activities along the east coast of Florida primarily comprise game and sport fishing, charter boat fishing, sailing, power cruising, sport diving, and other recreational boating activities. Recreational fishing and other recreational boats range throughout the coastal waters and throughout all four seasons. Many sites that are known as popular fishing areas (see Figure 3.4-2) also attract divers (DoN, 2008n). Popular fishing areas and other dive sites – including artificial reefs, coral patches, and shipwrecks – are utilized throughout the year by recreational vessels and commercial chartered boats, but use is highest during the summer. Florida ranks first in the nation for the number of recreational boats registered in the state, with 973,859 registered in 2005 (USCG, 2006).

Travel between the most popular cruising destinations along the Florida coast does not require traversing of the proposed Site A USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed range. Certain ocean passages for cruising vessels also might favor courses through the vicinity of the proposed site.

Site B

In the vicinity of the proposed Site B range, recreational activities primarily comprise game and sport fishing, charter boat fishing, sailing, power cruising, sport diving, and other recreational boating activities. Recreational fishing and other recreational boats range throughout the coastal waters and throughout all four seasons. Many sites that are known as popular fishing areas (see Figure 3.4-3) also attract divers (DoN, 2008n). Popular fishing areas and other dive sites – including artificial reefs, coral patches, and shipwrecks – are utilized throughout the year by recreational vessels and commercial chartered boats, but use is highest during the summer. South

Carolina ranks 8th in the nation for the number of recreational boats registered in the state, with 416,763 registered in 2005 (USCG, 2006).

Travel between the most popular cruising destinations along the South Carolina coast does not require traversing of the proposed Site B USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed range. Certain ocean passages for cruising vessels also might favor courses through the vicinity of the proposed site.

Site C

Recreational activities in the Cherry Point OPAREA primarily comprise game and sport fishing, charter boat fishing, whale watching, sailing, power cruising, sport diving, and other recreational boating activities. Recreational fishing and other recreational boats range throughout the North Carolina coastal waters, depending on season and weather conditions. North Carolina ranks 11th in the nation for the number of recreational boats registered in the state, with 362,784 boats registered (USCG, 2006).

Travel between the most popular cruising destinations along the North Carolina coast does not require traversing of the proposed Site C USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. To clear Cape Lookout and Frying Pan Shoals these boats may traverse the Cherry Point OPAREA at distances between 45 and 55 km (25 and 30 NM) or greater offshore of the New River Inlet. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed Site C range. Certain ocean passages for cruising vessels (e.g., from some North Carolina ports to the Bahamas or Bermuda) also might favor courses through the vicinity of the proposed site.

Site D

In the vicinity of the proposed Site D range, recreational activities are primarily comprised of game and sport fishing, charter boat fishing, whale watching, sailing, power cruising, sport diving, and other recreational boating activities. Virginia ranks 19th and Maryland ranks 24th in the nation for the number of recreational boats registered in these states, with 245,073 and 205,812 boats registered (respectively) in 2005 (USCG, 2006). Five artificial reefs are located offshore of the Virginia coast (Virginia Marine Resources Commission [VMRC], 2002). Three of these offshore artificial reefs – Blackfish Bank, Parramore Reef, and Wachapreague Reef – are located north of the mouth of Chesapeake Bay, shoreward of the proposed USWTR site. All three are situated within 17 km (9 NM) of shore, and at distances between 52 and 72 km (28 and 39 NM) from the proposed range site.

Shipping Intensity by Emissions

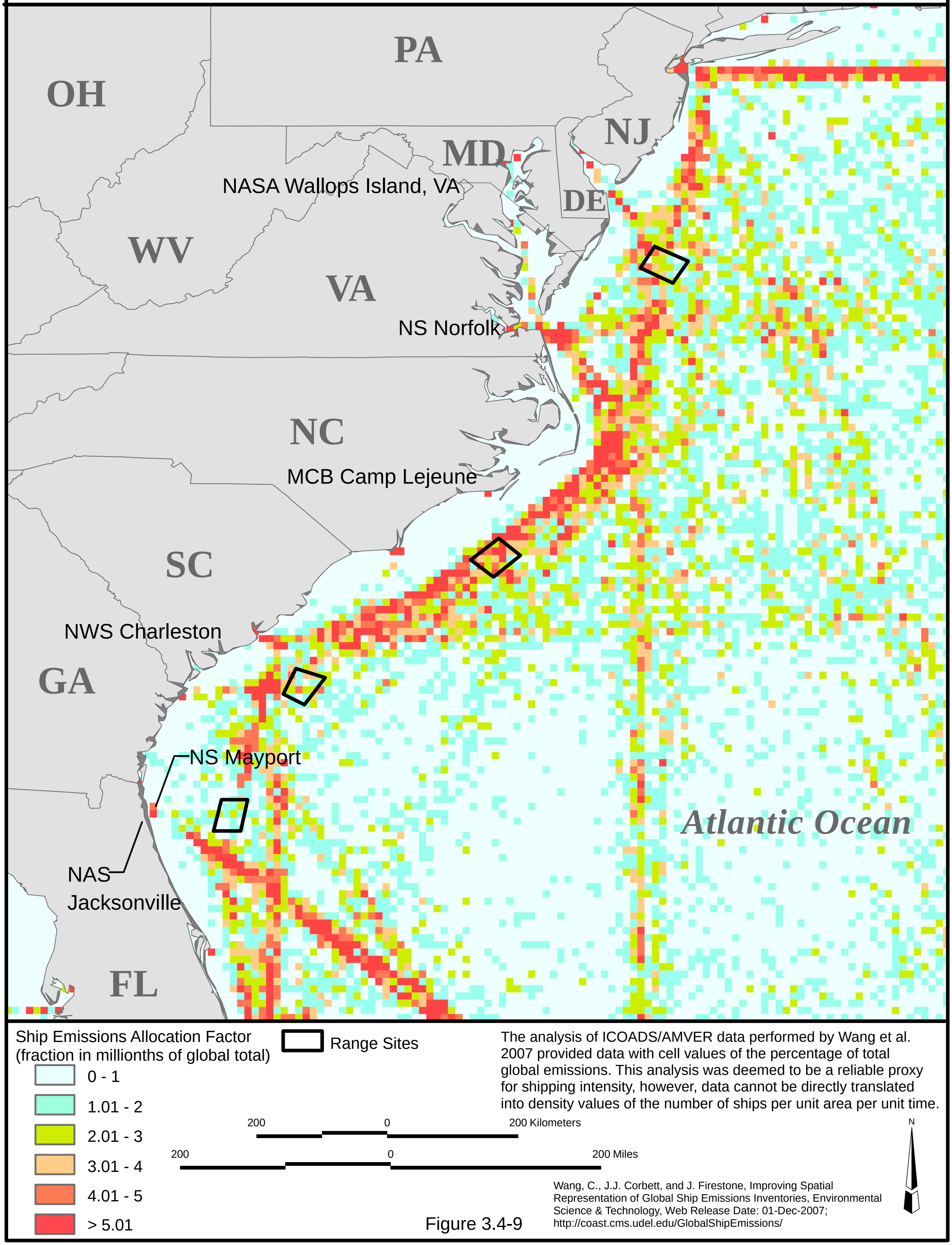


Figure 3.4-9

Travel between the most popular cruising destinations along the Maryland-Virginia coast does not require traversing of the proposed Site D USWTR. However, larger recreational vessels, in particular sailboats and motor cruisers in the 15-m (50-ft) and larger class, do travel considerable distances offshore. Further, depending on local wind conditions, sailboats in the 23-m (75-ft) and larger class may traverse the vicinity of the proposed range. Certain ocean passages for cruising vessels also might favor courses through the vicinity of the proposed site.

3.4.5 Scuba Diving

Scuba diving and snorkeling are popular recreational activities along the entire U.S. coastline but especially off the southeastern states, including Florida, South Carolina, and North Carolina, where warm water, much of it provided by the proximity of the Gulf Stream, is the primary attraction for divers. Although diving occurs year-round, it varies in intensity with season (i.e., there are more diver trips in summer than in winter).Divers visit certain dive sites on a frequent and/or regular basis. Scuba diving in the vicinity of the proposed USWTR sites consists of diving on wrecks, artificial reefs and hard bottom structures. Coral reefs at depths within recreational diving limits are not contained within any of the proposed USWTR sites. Many sites that are known as popular fishing areas also attract divers (see Figures 3.4-2, 3.4-3, 3.4-4 and 3.4-8).

In the Cherry Point and VACAPES OPAREAs, the preponderance of shipwrecks (see Subchapter 3.5; Figures 3.5-3 and 3.5-4) provides ideal diving locations. More than 1,000 ships have been lost along the North Carolina coast in the past four centuries (DoN, 2008l), with the highest concentrations of shipwrecks in the vicinity of Cape Hatteras. A number of shipwrecks are found in Onslow Bay and around the point of Cape Fear (Association of Underwater Explorers, 2006). The VACAPES OPAREA contains approximately 160 shipwrecks (DoN, 2008m). Shipwrecks in the Jacksonville and Charleston OPAREAs are fewer in number; however, other types of dive sites are popular, including live/hard bottom, artificial reefs, and the Gray’s Reef NMS (Discover Diving, 1999; NOAA, 2007c; Coastal Scuba, 2002). Dive boats from southeastern North Carolina, South Carolina, Georgia, and northeastern Florida visit dive sites located within the Jacksonville and Charleston OPAREAs (Florida Scuba Connection, 1998; Divers Supply, 2001; Mermaid Diving, 2002; Onslow Bay Departures, 2002).

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3.5 Cultural Resources at Sea

Potential cultural resources occurring at sea could include both archaeological sites and shipwrecks. *Archaeological sites may be present from Paleo-Indian habitation during the last ice age, when sea levels were much lower. These sites would occur in depths of less than approximately 100 m (330 ft). Sediment deposition rates along the Atlantic coast range from 0.3 to 1.6 cm (1 to 6 in) per year for Florida bays (Wingard et al., 2007) and for the continental shelf near Cape Hatteras, North Carolina range from 10 to 425 cm (4 to 167 in) per thousand years, with a mean of 106 cm (3.5 ft) per thousand years (values based on Alperin et al., 2002). These sedimentation rates provide an estimate of about 1 m (3.2 ft) every 1,000 years for the continental shelf and 3 m to 16 m (10 to 52 ft) every 1,000 years for areas closer to shore. The sediments accumulated beginning about 12,000 years ago would be more than enough to cover Paleo-Indian remains and provide a buffer between trenching activities and potential artifacts. Therefore, it is anticipated that these sites would be buried under sediments that have accumulated over the centuries (i.e., they would be buried well below the affected environment ranging from 1 to 3 m [3 to 10 ft], depending on site, where the trunk cable would be trenched as part of the proposed action) and it is anticipated that there would be no archaeological sites in the affected environment.* Therefore, the following discussion of cultural resources at sea at each proposed USWTR location relates only to shipwrecks, as they are the only predicted cultural resources to be potentially impacted by the proposed action.

The National Historic Preservation Act (NHPA) extends to federal undertakings outside the U.S. where (1) the undertaking may directly and adversely affect a property on the World Heritage List or on the applicable country's equivalent of the National Register, and (2) only requires that the head of the agency take into account the effect of the undertaking on such property for purposes of avoiding or mitigating any adverse effects (16 USC 470a-2). No shipwrecks within any of the proposed USWTR sites appear on the World Heritage List.

In accordance with the Sunken Military Craft Act, information was requested from the Naval History and Heritage Command (NHHC), Underwater Archaeology Branch and Cultural Resources Management Section. On April 9, 2009, the NHHC provided available data regarding the location of Navy shipwrecks and wrecked aircraft. These data were mapped and compared to the locations of the four alternative USWTR sites. No Navy shipwrecks or wrecked aircraft are located within any of the proposed USWTR sites.

3.5.1 Site A

The continental shelf off the southeastern U.S. has the potential for containing many shipwrecks. Merchantmen, ships-of-war, blockade-runners, cruise ships, and fishing vessels dating from the eighteenth century to the present have been sunk, lost, or run aground in the Jacksonville OPAREA. There are approximately 16 shipwrecks off the coast of northern Florida (DoN, 2008n).

NOAA's Automated Wreck and Obstruction Information System (AWOIS) and Captain Segull's Nautical Fishing Charts (Captain Segull, 2004) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist in the area of the proposed range (NOAA, 2004b, 2006c). Figure 3.5-1 depicts the results. As shown in the figure, most shipwreck and obstruction locations are inshore of the proposed USWTR location, with two shipwrecks located within Site A.

3.5.2 Site B

As noted for Site A, the continental shelf off the southeastern U.S. has the potential for containing many shipwrecks. Merchantmen, ships-of-war, blockade-runners, cruise ships, and fishing vessels dating from the eighteenth century to the present have been sunk, lost, or run aground off the coast of South Carolina, particularly in the vicinity of Charleston Harbor (Figure 3.5-2). Off the coast of Charleston, South Carolina there are various Civil War ships sunk (i.e., *Housatonic*, *Palmetto State*, the *Norseman*, the *Stonewall Jackson*, *Raccoon*, *Keokuk*, *Weehawken*, *U.S.S. Patapsco*, *HMS Acteon*, and the *Ruby*) (NUMA, 2006).

NOAA's AWOIS and Captain Segull's Nautical Fishing Charts (Captain Segull, 2004) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist in the area of the proposed range (NOAA, 2004b, 2006c); Figure 3.5-2 depicts the results. As shown in the figure, there is one shipwreck present in Site B.

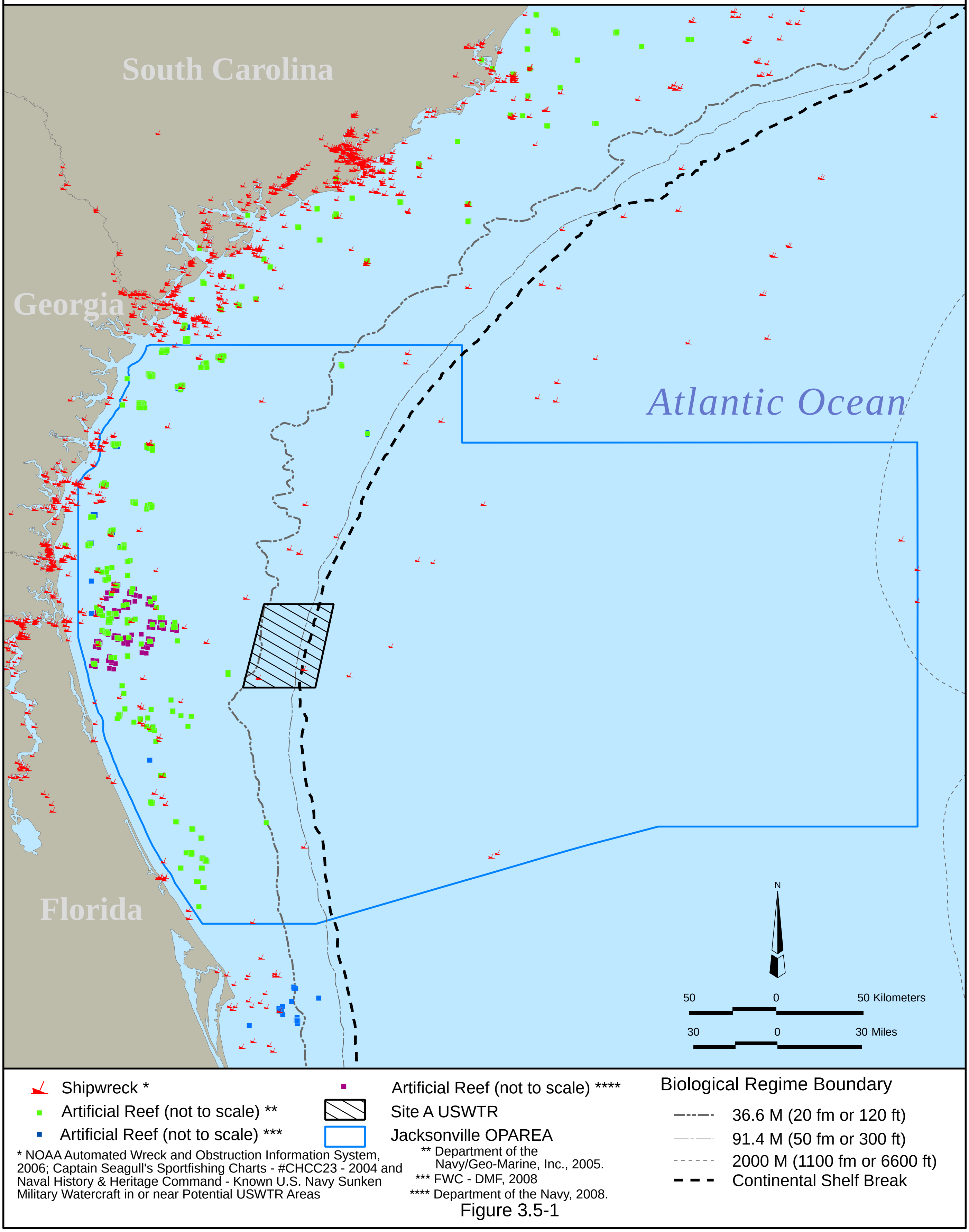
3.5.3 Site C

The South Atlantic continental shelf has the potential to contain many shipwrecks. The prominent capes (Hatteras, Lookout, and Fear) and their attending shoals (Diamond, Lookout, and Frying Pan); the powerful currents, winds, and treacherous seas; and the conflicts of wars are all responsible for the numerous shipwrecks off the coast of North Carolina (Newton et al., 1971).

Over a thousand ships have been lost along the North Carolina coast in the past four centuries, earning those waters the nickname "The Graveyard of the Atlantic." Some of these shipwrecks date to Colonial times (DoN, 2008l). The highest concentrations of shipwrecks are in the vicinity of Cape Hatteras, where the intersection of cold northern currents and the northbound Gulf Stream forms the shallows of the Diamond Shoals (Newton et al., 1971). Extending seaward over submerged, shallow, shifting sand bars for 31 km (17 NM), the Diamond Shoals create hazardous sea conditions for mariners.

NOAA's AWOIS and Captain Segull Nautical Fishing Charts (Captain Segull, 2004) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist within the proposed Site C USWTR area (NOAA, 2004b, 2006c). Figure 3.5-3 depicts the results, with four shipwrecks in Site C.

Approximate Locations of Shipwrecks and Artificial Reefs in the Jacksonville OPAREA



* NOAA Automated Wreck and Obstruction Information System, 2006; Captain Seagull's Sportfishing Charts - #CHCC23 - 2004 and Naval History & Heritage Command - Known U.S. Navy Sunken Military Watercraft in or near Potential USWTR Areas

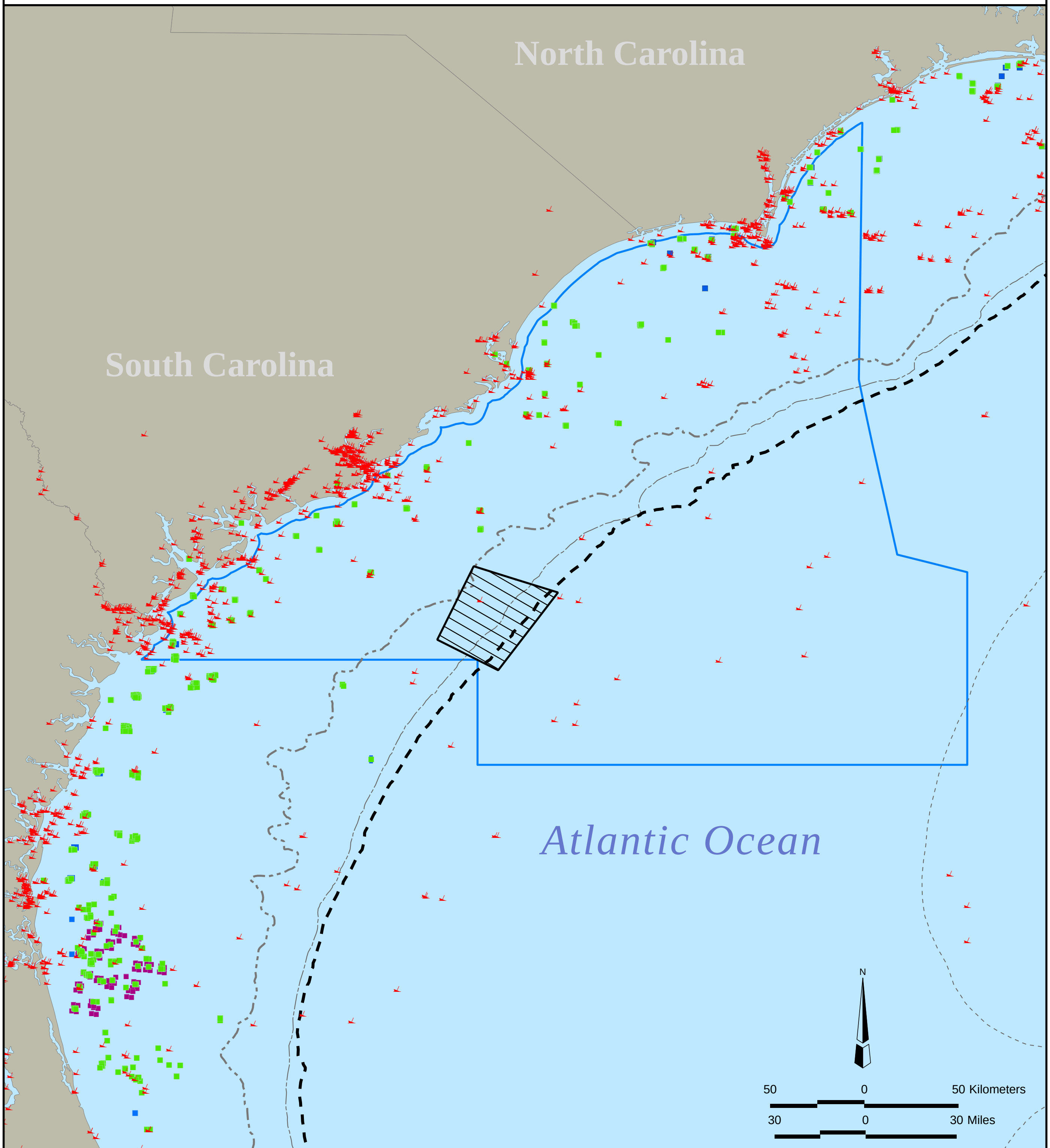
** Department of the Navy/Geo-Marine, Inc., 2005.

*** FWC - DMF, 2008

**** Department of the Navy, 2008.

Figure 3.5-1

Approximate Locations of Shipwrecks and Artificial Reefs in the Charleston OPAREA



Shipwreck *

Artificial Reef (not to scale) **

Artificial Reef (not to scale) ***

Artificial Reef (not to scale) ****

Site B USWTR

Charleston OPAREA

Biological Regime Boundary

36.6 M (20 fm or 120 ft)

91.4 M (50 fm or 300 ft)

2000 M (1100 fm or 6600 ft)

Continental Shelf Break

* NOAA Automated Wreck and Obstruction Information System, 2006; Captain Seagull's Sportfishing Charts - #CHCC23 - 2004 and Naval History & Heritage Command - Known U.S. Navy Sunken Military Watercraft in or near Potential USWTR Areas

** Department of the Navy/Geo-Marine, Inc., 2005.

*** FWC - DMF, 2008

**** Department of the Navy, 2008.

Figure 3.5-2

Approximate Locations of Shipwrecks and Artificial Reefs in the Cherry Point OPAREA

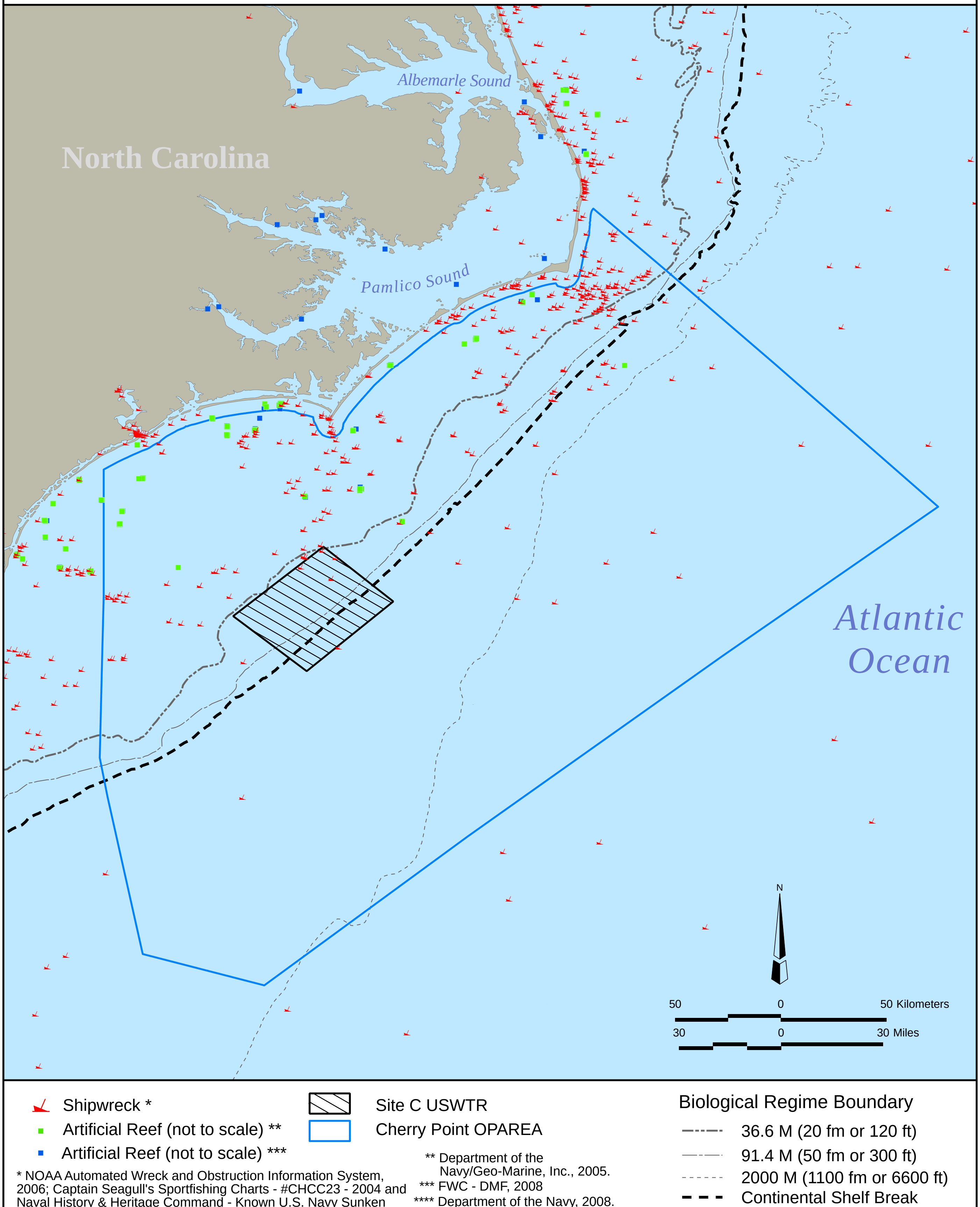


Figure 3.5-3

3.5.4 Site D

The VACAPES OPAREA contains approximately 160 shipwrecks (DoN, 2008m). NOAA's AWOIS and Captain Segull's Nautical Fishing Charts (Captain Segull, 2005) were queried to determine the best representation of the potential for shipwrecks and obstructions to exist in the area of the proposed range (NOAA, 2004b, 2006c). Figure 3.5-4 depicts the results. The database indicates that are four shipwrecks located within the proposed range site.

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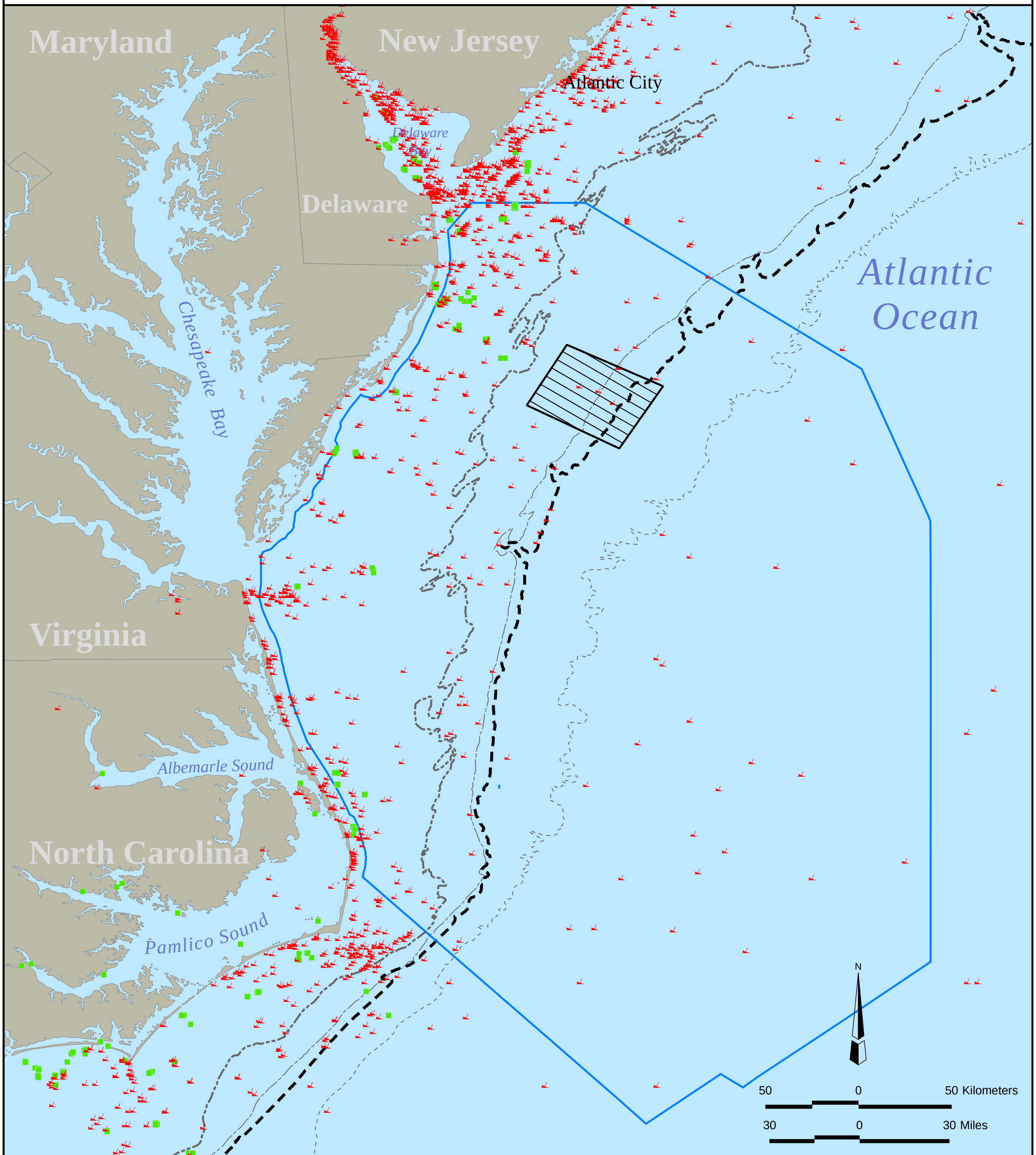
Approximate Locations of Shipwrecks and Artificial Reefs in the VACAPES OPAREA



Shipwreck *
Artificial Reef (not to scale) **

Site D USWTR
VACAPES OPAREA

Biological Regime Boundary
36.6M (20fm or 120ft)
91.4M (50fm or 300ft)
2000M (1100fm or 6600ft)
Continental Shelf Break

* NOAA Automated Wreck and Obstruction Information System, 2006; Captain Seagull's Sportfishing Charts - #CHCC23 - 2004 and Naval History & Heritage Command - Known U.S. Navy Sunken Military Watercraft in or near Potential USWTR Areas

** Department of the Navy/Geo-Marine, Inc., 2005.

Figure 3.5-4

3.6 Landside Environment

As described in Chapter 1, all text in this OEIS/EIS that describes the affected environment specific to NEPA (i.e., the landside environment) is in italics. Thus, this subchapter on the affected landside environment is italicized.

3.6.1 Site A

This section discusses the existing environment in and around the proposed cable landfall site for the proposed Site A at Naval Station (NS) Mayport (Figure 2-13). The trunk cable would be installed via a 10-cm (4-in) horizontal directionally drilled conduit from a point approximately 915 m (3,000 ft) offshore to a point inshore of the sand dunes. The trunk cable would then be placed in an excavated trench from the inshore exit point to the cable termination facility (CTF).

3.6.1.1 Land Use

NS Mayport is a 1,380-hectare (3,410-acre) facility located in northeastern Duval County, Florida. The northern one-third of NS Mayport is heavily developed as a military industrial and residential complex. This complex includes a 2.4-km (1.5-m) runway capable of handling any aircraft in the DoD inventory, along with a 66-hectare (162-acre) port facility capable of accommodating 34 ships (NS Mayport, 2004). NS Mayport services fleet assets including nuclear-powered aircraft carriers, cruisers, destroyers, and guided-missile frigates. The station's two aviation wings conduct more than 135,000 flight operations each year. These operations include long-range maritime surveillance by fixed-wing aircraft and ASW by rotary-wing aircraft (GlobalSecurity, 2004). The oceanfront beach is used primarily for housing, personnel support, and recreational activities (DoN, 2003a).

The Village of Mayport borders the installation to the northwest and is situated on a narrow strip of land along the St. Johns River The southern edge of NS Mayport is bordered by State Road A1A, Wonderwood Drive, and Kathryn Abbey Hanna Park (City of Jacksonville). North of the St. Johns River are Huguenot Park (City of Jacksonville), Little Talbot Island State Park, and Fort George Island Cultural State Park. Much of the land to the north of the installation is part of the Timucuan Ecological and Historic Preserve (National Park Service). The boundaries of the Timucuan Ecological and Historic Preserve also extend onto the southeastern portion of NS Mayport and overlap with approximately 1,150 acres of the installation (DoN, 2008b).

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). Appendix F of this final OEIS/EIS contains the Coastal Consistency Determination (CCD) submitted to the Florida Department of Environmental Protection (FLDEP) and the Negative Determination submitted to the Georgia Department of Natural Resources. Copies of the transmittal letters are contained in Appendix G.

3.6.1.2 Socioeconomics

Demographics

Table 3.6-1 presents the ethnic characteristics of Duval County compared to the state of Florida. Compared to the state as a whole, the county has a greater population of black or African-Americans (27.8 percent compared to 14.6 percent in the state). The percentages of the other ethnic groups are similar, except for the substantially lower number of Hispanics or Latinos in the county (4.1 percent) compared to Florida (16.8 percent). As shown in Table 3.6-2, Duval County has higher household and family income levels, at 4.5 to 5.0 percent higher than the state as a whole.

Table 3.6-1

Duval County Ethnic Characteristics

Jurisdiction	% Black	% Hispanic or Latino	% American Indian, Alaskan Native	% Asian, Pacific Islander
Duval County	27.8	4.1	0.3	0.1
Florida	14.6	16.8	0.3	0.1
Source: U.S. Census Bureau, 2004				

Table 3.6-2

Duval County Income and Poverty Status

Jurisdiction	Median Household Income	Median Family Income	Persons in Poverty[1]		Families in Poverty[1]	
			Persons	%	Families	%
Duval County	40,703	47,689	90,726	11.9	18,697	9.2
Florida	38,819	45,625	1,948,913	12.5	381,457	9.0
Notes: [1] 1999 income below poverty level. Population for whom poverty status is determined. Source: U.S. Census Bureau, 2004						

Environmental Justice

EO 12898, <u>Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations</u>, directs all federal departments and agencies to conduct programs, policies, and activities that substantially affect human health or the environment in a manner that does not exclude communities from participation in, deny communities the benefits of, nor subject communities to discrimination under such actions because of their race, color, or national origin. Factors used in determining consistency with this policy focus on the racial, income, and *ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site A USWTR landfall site are described above. The analysis to determine the proposed project's consistency with this policy is presented in Subchapter 4.6.*

EO 13045, Protection of Children from Environmental Health Risks and Safety Risks, requires each federal agency to identify and assess environmental health risks and safety risks to children. "Environmental health risks and safety risks" are defined as "risks to health or to safety that are attributable to products or substances that the child is likely to come in contact with or ingest." Federal actions that are covered and affected by this EO are those substantive actions that concern an environmental health risk or safety risk that an agency has reason to believe may disproportionately affect children. The analysis to determine the proposed project's consistency with this policy is presented in Subchapter 4.6.

3.6.1.3 Natural Resources

Navigable Waters

The Rivers and Harbors Act (RHA) was enacted to ensure that navigable waters are not obstructed or fouled by the placement of material or disposal of refuse in them. Under Section 10 of the act, 33 USC §403, a USACE permit is required for structures and/or work in or affecting navigable waters of the U.S. The RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to NS Mayport, which are navigable waters. The trenched placement of a cable in the navigable waterway adjacent to NS Mayport will require both a RHA permit and a Clean Water Act (CWA) permit. The CWA regulates the discharge of dredged or fill material in waters of the United States, and as the act of trenching to constitutes a discharge of dredged material, a CWA permit would be required.

Wetlands

In May 2004, wetland areas of the installation were mapped (DoN, 2008b). The wetlands were delineated in accordance with the 1987 Corps of Engineers Wetlands Delineation Manual (USACE, 1987). Approximately 789 hectares (1,950 acres) of freshwater and tidal saltwater wetlands habitats were identified. Of this total, 696 hectares (1,720 acres) are saltwater habitats and 93 hectares (230 acres) are freshwater wetland habitats. These wetland areas are characterized as salt marshes, freshwater marshes, forested swamps, and tidal streams. The majority of wetlands at NS Mayport consist of salt marsh and tidal creeks (DoN, 2004c). Additionally, wetlands exist along the southern shore of the NS Mayport entrance channel that are classified as emergent, estuarine, intertidal, persistent, and irregularly flooded (DoN, 2004c). Figure 3.6-1 presents the National Wetlands Inventory (NWI) information for NS Mayport. Based on this figure and a wetland delineation performed in 2004 (DoN, 2008b), there are no wetlands at the proposed cable termination facility or in the cable corridor.

Threatened and Endangered Species

Species listed as threatened or endangered under the ESA potentially occurring at NS Mayport or in nearshore areas are provided on Table 3.6-3.

Table 3.6-3

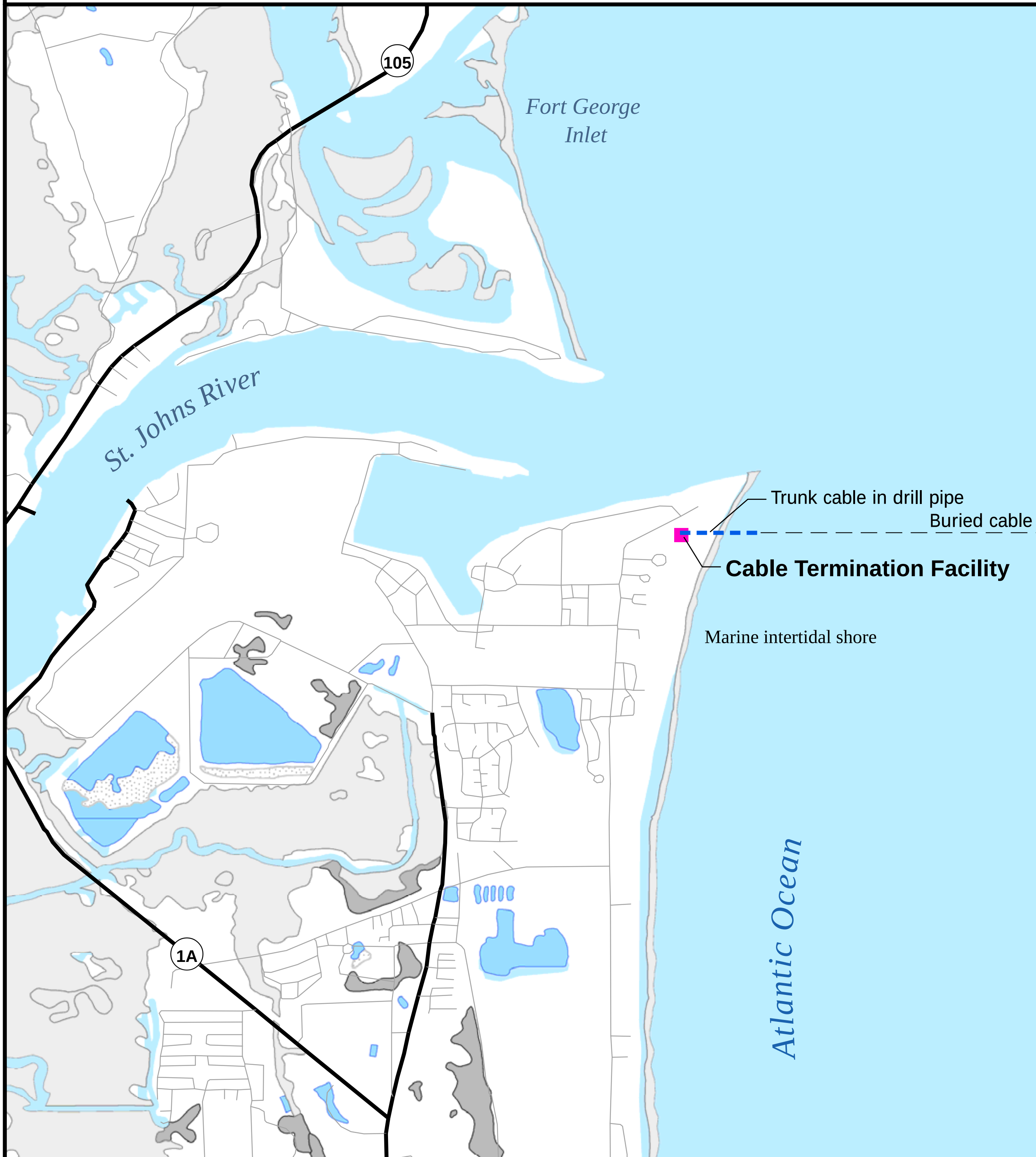
Federally Listed Plants and Animals Potentially Occurring at or Near Naval Station Mayport

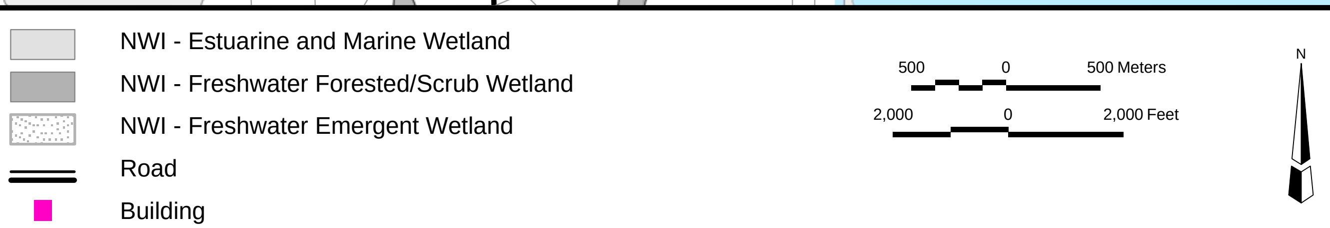
Common Name	Scientific Name	Federal Status
Birds		
Piping plover	*Charadrius melodus*	Threatened
Wood stork	*Mycteria americana*	Endangered
Reptiles		
Loggerhead sea turtle	*Caretta caretta*	Threatened
Green sea turtle	*Chelonia mydas*	Endangered
Hawksbill sea turtle	*Eremochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempi*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Smalltooth swordfish	*Pristis pectinata*	Endangered
Atlantic sturgeon	*Acipenser oxyrhinchus oxyrhinchus*	Candidate
Mammals		
Florida manatee[1]	*Tricheus manatus latirostris*	Endangered

Source: DoN, 2008b.
Notes: [1] This Species of Concern (SOC) is included because a determination to list this species may occur during the course of the EIS.
Florida manatee occurs in Atlantic coast off northeast Florida (DoN, 2008n).

An inventory conducted in 1995 by the Florida Natural Areas Inventory concluded that no federal or state threatened or endangered plant species were located on NS Mayport (DoN, 2003a). This is largely attributable to the lack of appropriate habitat on the station.

Site A National Wetlands Inventory (NWI)





Source: National Fish and Wildife Service, 1982

Figure 3.6-1

Birds

The piping plover (Charadrius melodus) breeds in only three geographic regions of North America – the Great Lakes, the northern Great Plains, and the Atlantic Coast. The northern Great Plains and Atlantic Coast populations were designated as threatened and the Great Lakes population was designated as endangered under the ESA in 1986 (USFWS, 2000). Atlantic Coast plovers nest on coastal beaches, sand flats at the ends of sand spits and barrier islands, gently sloped foredunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Plovers arrive on the breeding grounds from mid-March through mid-May and remain for three to four months per year (USFWS, 2002).

Designated critical habitat for wintering piping plovers is found to the north of NS Mayport and the St. Johns River on Fort George Island within Huguenot Memorial Park (USFWS, 2008). They are infrequent visitors to NS Mayport and Duval County beaches, but were observed at NS Mayport as recently as 2007 (DoN, 2008b). Otherwise, they are not expected to occur routinely within the NS Mayport (DoN, 2008b).

The federally endangered wood stork (Mycteria americana) nests and forages in estuarine wetlands. It is typically seen in North Florida during the nesting season from March through August (DoN, 2008b). Wood storks have been observed along the entrance channel, east of the NS Mayport turning basin (DoN, 2007c).

The American bald eagle (Haliaeetus leucocephalus) has also been documented on site. The bald eagle was delisted from the federal threatened and endangered species list on July 28, 2007 and is primarily protected under the Bald and Golden Eagle Protection Act of 1940 (BGEPA) (16 USC 668a-668d), and the Migratory Bird Treaty Act (MBTA) (16 USC 703-711).

Reptiles

Four species of sea turtles, the loggerhead (Caretta caretta), leatherback (Dermochelys coriacea), green (Chelonia mydas), and Kemp's ridley (Lepidochelys kempi) potentially occur at NS Mayport. Beaches extending from the south jetties of NS Mayport south through Jacksonville Beach within Duval County are nesting habitat for loggerhead, leatherback, and green turtles (DoN, 2008b). There have been no nests documented for Kemp's ridley in Duval County for the last 25 years (DoN, 2008b).

In the southeastern U.S., loggerhead nesting season begins in early May and lasts through early September (FFWCC, 2002), averaging 55 to 60 days for most clutches in Florida (USFWS, 2007a). Surveys conducted in 2006 and 2007 identified 103 and 36 loggerhead nests, respectively, along Duval County beaches (FFWCC-FWRI, 2006a, 2008a). Loggerheads have nested and continue to nest at NS Mayport beaches. Surveys began in 1998 with two nests recorded and have since grown to 21 nests and 1,177 loggerhead hatchlings in 2006, which is the largest on record at the Station (DoN, 2007c).

Leatherbacks typically nest along the beaches from Brevard County south to Broward County, south of NS Mayport, and nest in low numbers along the beaches of Duval County. Nesting occurs from March through July with an incubation period of 55 to 75 days (DoN, 2007c). Two leatherback nests were documented in Duval County in 2003, but none were recorded in recent years (e.g., FFWCC-FWRI, 2008).

Green turtle nesting season takes place from April through September with an incubation period of approximately two months (FFWCC 2002; DoN 2007c). Surveys conducted in 2006 and 2007 identified four green turtle nests in both years along Duval County beaches (FFWCC-FWRI, 2006a, 2008); however, there are no records of them nesting at NS Mayport beaches (DoN, 2008b). Green turtles have been recorded in the NS Mayport turning basin (USACE, 2001).

Federally threatened loggerhead sea turtles nest on the beach at NS Mayport. Known locations of sea turtle nests are marked with protective fencing (DoN, 2003a). The nesting season typically runs from May 1 through October 31 of each year,

Fish

*The shortnose sturgeon (*Acipenser brevirostrum*) recovery plan completed in 1998 contained no population data available for the St. Johns River in Florida and recommended research on this population (NMFS, 1998d). As described in Subchapter 3.2.8.1, intensive sampling for shortnose sturgeon in the area yielded only one individual and it is highly unlikely that any sizable population of the shortnose sturgeon currently exists in the St. Johns River or its tributaries (FFWCC-FWRI, 2007b). There is no documented reproduction in the St. Johns River and no large adults have been positively identified, indicating that the infrequent catches are transients from other river systems (FFWCC, 2005d; Holder, 2007). Shortnose sturgeon are known to use warm-water springs in other southern rivers, but none have been observed in the numerous warmwater springs found in the St. Johns River system (FFWCC-FWRI, 2007b). Therefore, the occurrence of shortnose sturgeons within the NS Mayport turning basin, entrance channel, and federal navigation channel is considered very unlikely (DoN, 2008b), as is their occurrence in the nearshore areas off the proposed cable landfall site.*

*Smalltooth sawfish (*Pristis pectinata*) inhabit coastal and estuarine shallow waters close to shore with muddy and sandy bottoms, particularly at river mouths. Regular occurrence of the species is restricted to the southern tip of Florida from the Caloosahatchee River (near Fort Myers) down to the Florida Keys (NMFS, 2006o). Therefore, it is considered very unlikely that smalltooth sawfish would occur within the nearshore areas off proposed cable landfall site.*

*The St. Johns River constitutes the southern end of the Atlantic sturgeon (*Acipenser oxyrhinchus oxyrhinchus*) range (ASSRT, 2007). Due to habitat degradation, the St. Johns River is suspected to serve as only a nursery for existing Atlantic sturgeon that still utilize the waterway system (NMFS and USFWS, 1998b). Only 37 percent of Atlantic sturgeon riverine habitat still exists in the St. Johns River. It is not currently used for spawning and historical use of the river is* *unknown (ASSRT, 2007). Therefore, it is unlikely that the Atlantic sturgeon will inhabit the nearshore areas in the vicinity of the proposed cable landfall.*

Mammals

*The Florida manatee (*Tricheus manatus latirostris*) is a federally-listed endangered species. Two groups of manatees reside in the Jacksonville area. One group remains in the area all winter while the other group moves south during the winter (DoN, 2007c). Individual manatees have been observed on average six times per year near the water treatment plant outfall along the south side of the entrance channel of NS Mayport (DoN, 2007c). They have also been observed in the turning basin of NS Mayport on occasion (DoN, 2007c) and may occur within nearshore areas (DoN, 2008b). There is designated critical habitat for the Florida manatee in the vicinity of NS Mayport. This area encompasses the entire St. Johns River from its headwater to the mouth of the Atlantic Ocean.*

Essential Fish Habitat

As described in Subchapter 3.2.4, nearshore EFH is defined as state waters (i.e., waters from estuaries to 5.5 km [3 NM] from shore) which include tidal freshwater; estuarine emergent vegetated wetlands (flooded salt and brackish marshes, marsh, and tidal creeks); submerged rooted vascular plants (seagrasses); oyster reefs and shell banks; soft sediment bottom, hard bottom, ocean high salinity surf zones, artificial reefs, and estuarine water column (SAFMC, 1998a). EFH off Site A comprises a small percentage (0.3 percent) of the corridor. The linear path in which the trunk cable will be laid has not been mapped, but may cross nearshore EFH, such as hard bottom or SAV EFH at the USWTR landfall site at NS Mayport.

Migratory Birds

A migratory bird is defined as any species or family of birds that lives, reproduces, or migrates within or across international borders at some point during its annual life cycle. There are 836 bird species protected by the MBTA.

*The NS Mayport is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. As at the other sites, migratory shorebirds feed on invertebrates on the beach portion of NS Mayport and seek shelter in vegetation adjacent to the beach. Thus, suitable habitat for migratory birds may exist in the vicinity of the proposed landfall site at NS Mayport. This habitat could support nesting least tern (*Sternula antillarum*), Wilson's plover (*Charadrius wilsonia*), and American oystercatcher (*Haematopus palliates*), and the more common gulls, terns, and skimmers that are found along the Atlantic coast.*

Vegetation and Soils

A beach dune community occurs along the length of NS Mayport's Atlantic oceanfront. The community is of marginal quality, mostly due to encroachment by roads, exotic turf grasses, and other development activities (e.g., houses, parking facilities). Three vegetative communities comprise the beach dune community: (1) foredune, (2) herbaceous flat, and (3) shrub zone (DoN, 2003a).

- *The foredune, or the most seaward portion of the dune, is dominated by sea oats (Uniola paniculata), beach hydrocotyle (Hydrocotyle bonariensis), gulf croton (Croton punctatus), and seaside evening primrose (Oenothera humifusa).*

- *The herbaceous flat, immediately landward of the foredune, is dominated by sea oats, camphor weed (Heterotheca subaxillaris), sand bean (Strophostyles helvola), prickly pear (Opuntia stricta), beach hydrocotyle (Hydrocotyle bonariensis), and contains a small area dominated by salt meadow cord grass (Spartina patens).*

- *The shrub zone, landward of the herbaceous flat, is dominated by wax myrtle (Morella cerifera), beach elder (Iva imbricata), cabbage palm (Sabal palmetto), salt bush (Baccharis angustifolia), muscadine (Vitis rotundifolia), and passion flower (Passiflora incarnata).*

Landward of the dunes, vegetation predominantly consists of landscape turf grasses, shrubs, and trees typical of an urban area.

In general, the soils located on NS Mayport are high in permeability and tend to be low in organic content and available water with the exception of the mucky peat soils (DoN, 2008b). Soils present near the proposed cable landfall site are primarily classified as arents, which are somewhat poorly drained, nearly level, non-hydric soils found in the coastal plain (USDA NRCS, 2004) and are generally characterized by being reworked during manmade earth moving operations (DoN, 2008b). There are also soils characterized as urban.

With its position immediately south of the stabilized entrance of the St. John's River, much of the beachfront at NS Mayport is sheltered from erosion-inducing wave action. Therefore, the shoreline is relatively stable. However, south of this sheltered area, coastal erosion rates are estimated at approximately 1.7 m (5.5 ft) per year (Foster et al., 2000). The progressively southward spreading erosion pattern has essentially been held in check by numerous beach nourishments since 1963 (DoN, 2008b).

Floodplain Management

EO 11988 sets forth federal agency responsibilities for reducing the risk of flood loss or damage to personal property, minimizing the impact of flood loss, and restoring the natural and *beneficial functions of floodplains. The proposed Site A USWTR landside site lies within the 100-year floodplain. The proposed cable termination facility construction and burial of the trunk cable are not likely to further exacerbate flooding.*

3.6.1.4 Cultural Resources

The National Historic Preservation Act (NHPA) was passed in 1966 to provide for the protection, enhancement, and preservation of any property that possesses significant architectural, archaeological, historical, or cultural characteristics. Under the regulatory program implementing the NHPA, a federal agency must first determine if the undertaking will affect a resource that is on or eligible for listing on the National Register of Historic Places.

A comprehensive survey was conducted during August 1993 to determine the extent and location of cultural resources at NS Mayport. One site, the St. John's Lighthouse located on the western boundary of NS Mayport (USACE, 1995), has been listed in the National Register of Historic Places (NRHP), while four others have been determined eligible for listing in the NRHP (DoN, 2003a). None of these areas would be impacted by the cable installation, as there would be no overlap with the landfall site, located on the eastern end of the installation at the entrance to the St. Johns River (Figure 2-14).

Underwater resources, including shipwrecks, cannons, Native American canoes, and other resources have been found in the vicinity of the St. Johns River entrance and associated tributary rivers and creeks (DoN, 2008b); however there are no known underwater cultural resources on the Atlantic shore near the proposed cable route.

3.6.1.5 Air Quality

NS Mayport is located in an area that is in attainment for all the criteria pollutants and is further classified as being an attainment/maintenance area for ozone. Maintenance areas are areas previously classified as non-attainment that have successfully reduced air pollutant concentrations to below the standard, but must maintain some of the non-attainment area plans to stay in compliance with the standards (Florida Department of Environmental Protection [FLDEP], 2002).

3.6.1.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at NS Mayport. There are two areas of petroleum contamination (#351, #413) and a solid waste management unit (SWMU-14), which is primarily petroleum contamination close to the proposed USWTR landside facility (Mitchell, 2008). The petroleum contamination areas can be easily avoided, as they are small and localized under buildings. SWMU-14 is underneath a very large concrete apron previously used for fire-fighting and can also be avoided.

3.6.2 Site B

This subchapter discusses the existing environment in and around the proposed cable landfall site for the proposed Site B USWTR at the Fort Moultrie National Monument. The trunk cable conduit at Site B would be installed similarly to Site A, under the dunes to the east of the CTF with the seaward end of the conduit connected to underground cable in a trench. Commercial power and telecommunications connections for the cable would be made at the Fort Moultrie National Monument. The communications signals would be routed to the ROC at FACSFAC VACAPES and electronics would be housed at the terminal end of the communications link.

3.6.2.1 Land Use

Fort Moultrie is the name of a series of forts on Sullivan's Island, South Carolina, built to protect the city of Charleston, South Carolina. Fort Moultrie is a historical unit of the National Park Service. The Fort Moultrie National Monument is 81 hectares (200 acres).

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). If Site B is selected, a CCD would be submitted to, and concurrence sought from, the South Carolina Department of Health and Environmental Control (SCDHEC).

3.6.2.2 Socioeconomics

Demographics

Table 3.6-4 presents the ethnic characteristics of Charleston County compared to the state of South Carolina. Compared to the state as a whole, the county has a slightly greater population of black or African-Americans (35.0 percent compared to 29.9 percent in the state). The percentages of the other ethnic groups are similar.

Table 3.6-4

Charleston County Ethnic Characteristics

Jurisdiction	% Black	% Hispanic or Latino	% American Indian, Alaskan Native	% Asian, Pacific Islander
Charleston County	35.0	2.4	0.6	1.4
South Carolina	29.9	2.4	0.7	0.1
Source: U.S. Census Bureau, 2000				

As shown in Table 3.6-5, Charleston County has higher household and family income levels, at 2.2 to 6.6 percent higher than the state as a whole. However, a greater percentage of people and families are in poverty than South Carolina as a whole.

Table 3.6-5

Charleston County Income and Poverty Status

Jurisdiction	Median Household Income	Median Family Income	Persons in Poverty[1]		Families in Poverty[1]	
			Persons	%	Families	%
Charleston County	37,810	47,139	50,830	16.4	9,603	12.4
South Carolina	37,082	44,227	565,694	14.1	114,721	10.7

Notes: [1] 1999 income below poverty level. Population for whom poverty status is determined.
Source: U.S. Census Bureau, 2004

Environmental Justice

Factors used in determining consistency with EO 12898 focuses on the racial, income, and ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site B USWTR are described above. The analyses to determine the proposed project's consistency with EOs 12898 and 13045 are presented in Subchapter 4.6.

3.6.2.3 Natural Resources

Navigable Waters

As described for Site A, the RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to the Fort Moultrie National Monument. The trenched placement of a cable in the navigable waterway adjacent to the Fort Moultrie National Monument will require both a RHA permit and a CWA permit.

Wetlands

Wetland communities identified in and around Fort Moultrie include marine intertidal unconsolidated shoreline along the coast and palustrine emergent and scrub-shrub wetlands behind the shoreline. The area behind Sullivan's Island contains palustrine and estuarine wetlands. Figure 3.6-2 presents the NWI information for Sullivan's Island. Based on this figure, there are no wetlands at the proposed cable termination facility or in the cable corridor.

Threatened and Endangered Species

Table 3.6-6 lists federally listed plants and animals recorded in Charleston County, South Carolina.

Of the plants listed, pondberry (<u>Lindera melissifolia</u>*) is not expected to be found at the Site B landfall site, as it is associated with wetland habitats such as bottomland and hardwoods in the interior areas, and the margins of sinks, ponds and other depressions in the more coastal sites (Clemson University, 2007). Although it is listed by the USFWS, it is not on South Carolina's rare, threatened, and endangered inventory list for Charleston County (SCDNR, 2007) nor was it recorded in the area during a natural resources survey (Byrne, 2007).*

Table 3.6-6

Federally Listed Plants and Animals Potentially Occurring at or Near Fort Moultrie

Common Name	Scientific Name	Federal Status
Plants		
Sea-beach amaranth	*Amaranthus pumilus*	Threatened
Canby's dropwort	*Oxypolis canbyi*	Endangered
Pondberry	*Lindera melissifolia*	Endangered
American chaffseed	*Schwalbea americana*	Endangered
Birds		
Piping plover	*Charadrius melodus*	Threatened
Wood stork	*Mycteria americana*	Endangered
Red-cockaded woodpecker	*Picoides borealis*	Endangered
Bachman's warbler	*Vermivora bachmanii*	Endangered
Reptiles		
Loggerhead sea turtle	*Caretta caretta*	Threatened
Green sea turtle	*Chelonia mydas*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Smalltooth swordfish	*Pristis pectinata*	Endangered
Atlantic sturgeon	*Acipenser oxyrhinchus*	Candidate
Mammals		
West Indian manatee	*Tricheus manatus*	Endangered
Source: USFWS, 2007b		

Site B National Wetlands Inventory (NWI)

Source: National Fish and Wildlife Service, 1989.

Figure 3.6-2

Birds

*Of the threatened and endangered bird species listed for Charleston County, the red-cockaded woodpecker (*Picoides borealis*) is unlikely to be found at the Site B landfall site and was not recorded on site (Byrne, 2007), as their nesting/roosting habitat consists of open stands of pine containing trees 60 years old and older (USFWS, 2007b). Red-cockaded woodpeckers need live, large older pines in which to excavate their cavities.*

*Bachman's warbler (*Vermivora bachmanii*) is also unlikely to be found at the Site B landfall site, as it is dependent on old-growth bottomland forest or areas that have been disturbed with dense understories of palmetto and cane, and was not recorded on site (Byrne, 2007). It has been documented at Cape Romain National Wildlife Refuge, located about 60 km (37 mi) northeast of Fort Moultrie National Monument (USFWS, 20007c).*

Piping plovers have not been observed over-wintering on Sullivan's Island during surveys conducted on the South Carolina coast in 1997, 1998, and 1999 (Dodd et al., 1999). There is no designated critical wintering habitat for the piping plover in the vicinity of Site B (USFWS, 2008). Kiawah Island, south of Charleston, is an important wintering area for piping plover (Dodd et al., 1999).

*Wood storks typically nest in the upper branches of black gum (*Nyssa biflora*) or cypress (*Taxodium distichum*) trees that are in standing water. In South Carolina, colony sites are surrounded by extensive wetlands, in particular palustrine forested wetlands (Murphy, 2008). Wood storks are tactile feeders, feeding almost exclusively on fish between 2 and 25 cm (1 to 10 in) in length (USFWS, 1996). They frequently feed in large groups in open wetlands where prey species are available and water depths are less than 50 cm (20 inches). Wood storks are unlikely to be found in the vicinity of the proposed cable landfall site owing to the absence of appropriate habitat.*

Reptiles

The federally threatened loggerhead sea turtle is the only sea turtle know to nest on Sullivan Island and the adjacent Isle of Palms. In 2007, three turtle nests were found on Sullivan Island (Island Turtle Team, 2007). More extensive loggerhead nesting has been documented on the beach at Folly Beach, on the southern side of Charleston Harbor. There is a turtle watch program that provides daily monitoring of nesting turtles (Folly Beach Turtle Watch Program, 2007). Known locations of sea turtle nests are marked.

Fish

Shortnose sturgeons were documented in what is now the metro Charleston area during the late 1800s (NMFS, 1998d), and more recently were collected in this heavily altered (dammed and urbanized) drainage in the 1980s during research on the American shad fishery. Population *dynamics are unknown. Based on the limited number of individuals in the area, shortnose sturgeon may rarely occur in the nearshore areas off the proposed cable landfall site.*

Records of the smalltooth sawfish from South Carolina are sparse (NMFS, 2006o). Due to the scarcity of this species and their preference for estuarine shallow waters close to shore with muddy and sandy bottoms, it is considered very unlikely that smalltooth sawfish would occur in the nearshore area off the proposed cable landfall site.

The Atlantic sturgeon has been documented in the Cooper River, which flows into Charleston Bay and subadult Atlantic sturgeon form winter aggregations in the shipping channel outside Charleston Harbor (ASSRT, 2007). Atlantic sturgeon may potentially be present in nearshore waters off of proposed cable landfall site.

Mammals

The Florida manatee has been sighted around Charleston Harbor and may occur in nearshore waters off the proposed cable landfall site

Essential Fish Habitat

As described in Subchapter 3.2.4, EFH off Site B comprises a small percentage (0.7 percent) of the corridor. The linear path in which the trunk cable will be laid has not been mapped, but may cross nearshore EFH, such as estuaries, coastal embayments, wetlands, water column, oyster reefs, SAV, and other hard and soft benthic substrates.

Migratory Birds

Fort Moultrie is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. As at the other sites, migratory shorebirds feed on invertebrates on the beach portion of Fort Moultrie and seek shelter in vegetation adjacent to the beach. Thus, habitat for migratory birds exists in the vicinity of the proposed landfall site at Fort Moultrie, although a study on migratory North American birds concluded that the prevalent wooded habitat around Charleston Harbor is of relatively low value to migratory birds (Post, 2001).

Vegetation and Soils

Sullivan's Island is one of three barrier islands east of the Cooper River. Sullivan's Island is unique in that the beachfront lands which have accreted over the years are owned by the Town of Sullivan's Island and held in a perpetual easement by the Low Country Open Land Trust protecting the natural environment along the Atlantic Ocean (Town of Sullivan's Island, 2007). A beach dune community occurs along the undeveloped portion of the island.

The soil survey of Charleston County, South Carolina, identifies the soil series at Sullivan Island as coastal beaches and dune land along the edge of the island, made land behind the beach area, and tidal marsh behind the made land (USDA and SCAES, 1971). Coastal beaches and dune land consist of sandy shoreline and sand dunes that border the Atlantic Ocean (USDA and SCAES, 1971). The shoreline areas are nearly level fine sand beaches that are flooded twice daily by tides. The dunes, which are formed by wind, are mounded areas of dry, loose very pale brown to yellow sand. Made land is present in areas that have been excavated, filled, or otherwise disturbed by man (USDA and SCAES, 1971). This area may contain variable amounts of sand, silt, and clay, or a mixture of these materials. The soft tidal marsh behind Sullivan's Island has a surface layer of dark colored soft clay, clay loam, muck, or peat and is saturated (USDA and SCAES, 1971). It is underlain by gray to dark gray soft textured fine clayey material that is permanently saturated. This area is covered by water at high tide.

Floodplain Management

The proposed Fort Moultrie USWTR landside site lies within the 100-year floodplain. The proposed cable termination facility construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.2.4 Cultural Resources

Sullivan's Island has played an important role in the region's history since the earliest days of English settlement in South Carolina (Town of Sullivan's Island, 2007). Fort Moultrie was deactivated in 1947 and most of the property was dispersed by the War Assets Administration, either being sold to private individuals or turned over to the State of South Carolina or the Township of Sullivan's Island. At the present time, the old section of Fort Moultrie, as well as Battery Jasper, is part of the Fort Sumter National Monument, administered by U.S. National Park Service as a historic site (Town of Sullivan's Island, 2007).

3.6.2.5 Air Quality

Fort Moultrie is located in an area that is in attainment for all the criteria pollutants and is also an attainment/maintenance area for ozone (SCDHEC, 2007). Maintenance areas are areas previously classified as non-attainment areas that have successfully reduced air pollutant concentrations to below the standard, but must maintain some of the non-attainment area plans to stay in compliance with the standard.

3.6.2.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at Fort Moultrie.

3.6.3 Site C

This section discusses the existing environment in and around the proposed cable landfall site at Onslow Beach. A trunk cable would run from a junction box located at the nearshore edge of the range to the vicinity offshore and north of Riesley Pier on Onslow Beach at Camp Lejeune. The trunk cable would then run through a 10-cm (4-in) underground conduit, which would be installed via horizontal directional drilling. The conduit would extend from a point approximately 915 m (3,000 ft) offshore, underneath the shoreline, beach, and Intracoastal Waterway. The conduit would be trenched from the Intracoastal Waterway to the CTF. The CTF would be built in the vicinity of Mockup Road to house the power supplies, system electronics, and communications gear.

3.6.3.1 Land Use

Onslow Beach is a barrier island within the boundaries of MCB Camp Lejeune, in Onslow County, North Carolina. MCB Camp Lejeune comprises over 48,500 hectares (120,000 acres), including 23 km (14 mi) of Atlantic Ocean shoreline.

The majority of the Onslow Beach shoreline is restricted from recreational use and is reserved for amphibious landing training and other beachfront training maneuvers. With respect to the specific landfall site (i.e., vicinity of Riesley Pier), the area to the north of the pier is used for authorized recreational use. The beach south of the pier is a designated military training area, conditionally available for permitted recreational uses.

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). If Site C, is selected a CCD would be submitted to, and concurrence sought from, the North Carolina Department of Environment and Natural Resources.

3.6.3.2 Socioeconomics

Demographics

Table 3.6-7 presents the ethnic characteristics of Onslow County compared to the state of North Carolina. The table indicates that the minority populations represent a relatively small proportion of the total population. Compared to the state of North Carolina as a whole, the county has generally similar population ethnicity characteristics; the largest relative difference is in the greater percentage (2.6 percent more) of Hispanics or Latinos residing in the county compared to the state. The relative proportions of the three other ethnicities are all lower in Onslow County in comparison to all of North Carolina.

Table 3.6-7

Onslow County Ethnic Characteristics

Jurisdiction	% Black	% Hispanic or Latino	% American Indian, Eskimo, Aleut	% Asian, Pacific Islander
Onslow County	18.2	7.2	0.8	0.3
North Carolina	21.4	4.6	1.2	1.9
Source: U.S. Census, 2000.				

As shown in Table 3.6-8, Onslow County has considerably lower household and family income levels than the state as a whole; these county income levels are about 13.6 and 20.8 percent less, respectively, than the state levels. However, the county percentages of the numbers of persons in poverty and the numbers of families in poverty are comparable to those of North Carolina.

Table 3.6-8

Onslow County Income and Poverty Status

Jurisdiction	Median Household Income	Median Family Income	Persons in Poverty[1]		Families in Poverty[1]	
			Persons	%	Families	%
Onslow County	33,756	36,692	16,917	12.9	3,994	10.8
North Carolina	39,061	46,335	958,667	12.3	196,423	9.0
Notes :[1] 1999 income below poverty level. Population for whom poverty status is determined Source: U.S. Census, 2000.						

Environmental Justice

Factors used in determining consistency with EO 12898 focus on the racial, income, and ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site C USWTR are described above. The analyses to determine the proposed project's consistency with EOs 12898 and 13045 are presented in Subchapter 4.6.

3.6.3.3 Natural Resources

Navigable Waters

As for Sites A and B, the RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to Onslow Beach. Navigation considered with respect to the Onslow Beach landfall site is the movement of recreational and commercial boating/shipping along the Atlantic Intracoastal Waterway (AIWW) and Onslow Bay (coastal Atlantic Ocean).

The trenched placement of a cable in the navigable waterway adjacent Onslow Beach will require both a RHA permit and a CWA permit.

Wetlands

The USFWS NWI map indicates that the beach portion of the affected environment is classified as marine, intertidal, irregularly flooded unconsolidated shore (M2USP) (Figure 3.6-3). Other wetlands to the west of Onslow Beach include estuarine intertidal scrub-shrub, broad-leaved deciduous irregularly flooded (E2SS1P), and estuarine intertidal emergent persistent regularly flooded (E2EM1N) (Figure 3.6-3). A USACE Section 404 permit is required for the placement of dredged or fill material in waters of the U.S. Waters of the U.S. generally consist of all surface waters other than waters isolated from navigable waters.

Threatened and Endangered Species

The USFWS Raleigh, North Carolina, field office lists several federally listed threatened and endangered species as occurring in Onslow County and surveys performed at Camp Lejeune have identified which of these species are present (Table 3.6-9).

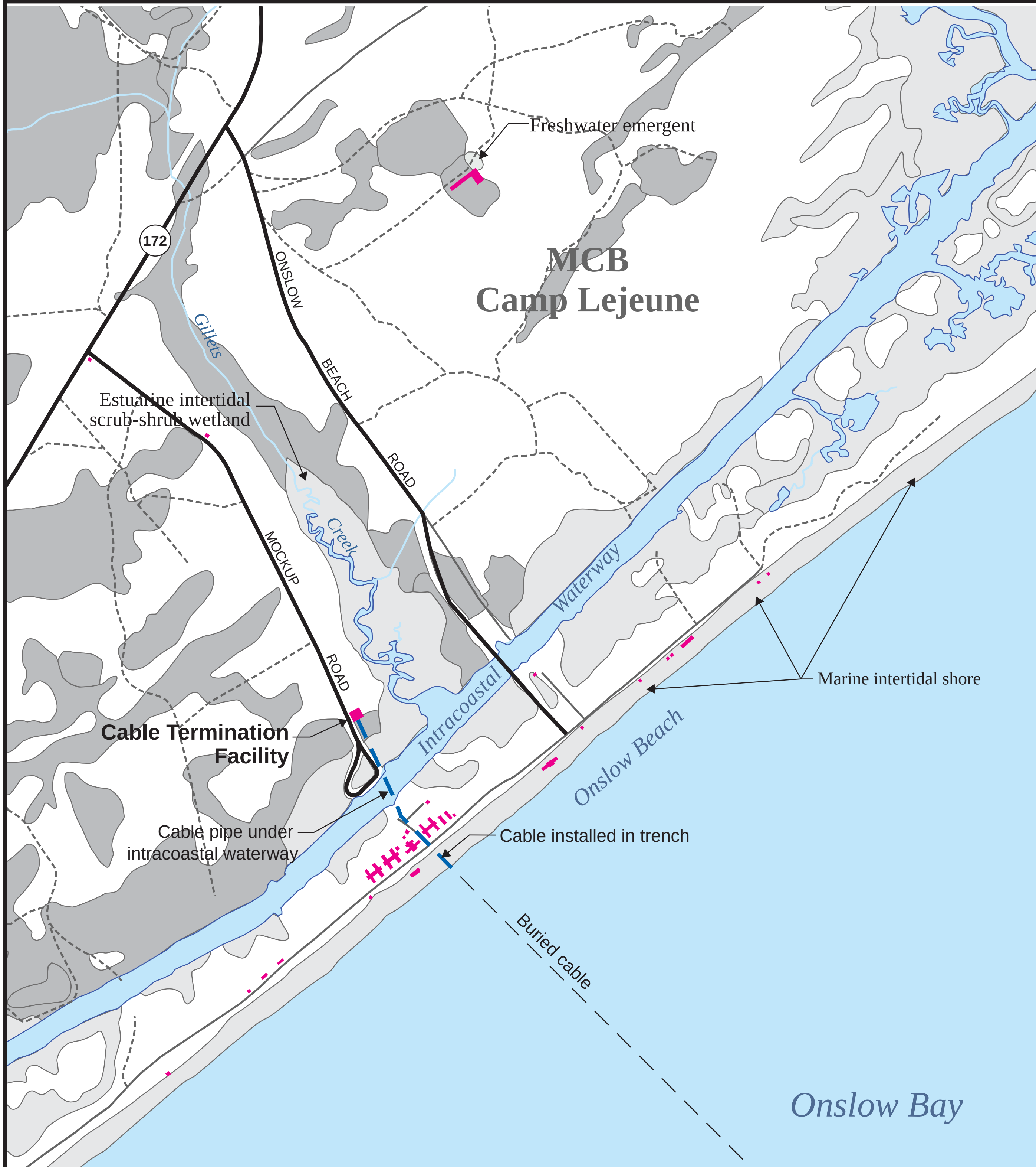
Plants

*Seabeach amaranth (*Amaranthus pumilus*) was listed as threatened under the ESA on April 7, 1993. It is an annual plant that grows from South Carolina to New York on Atlantic barrier islands and ocean beaches, primarily in disturbed areas such as overwash flats, accreting areas near inlets, and on lower foredunes and upper strands of non-eroding beaches, and may serve as a dune-building pioneer species (USFWS, 2002).*

Three main seabeach amaranth aggregations have been identified on Onslow Beach. These are located in the immediate vicinity of the Onslow North Tower, in the washover flat south of the Onslow South Tower, and at New River inlet. Two hundred germinations were estimated in 1998, 25 in 1999, and 12 in 2000. Fifteen to 20 plants were found in 2001. The aggregation at the Onslow North Tower was detected in the late 1980s and rediscovered during a 1998 survey. A grouping of several plants occurred 320 m (1,050 ft) south of the tower, and another two individuals were found at 480 m (1,575 ft) and 640 m (2,100 ft) north of the tower (USFWS, 2002).

Because seabeach amaranth is an annual plant, and its location cannot be reliably predicted from year to year, all possible habitat locations are surveyed each summer beginning in June to ensure that populations receive adequate protection (DoN, 2006a). Once identified, seabeach amaranth sites are marked with signs to prevent traffic from harming the plants.

Site C National Wetlands Inventory (NWI)



NWI - Estuarine and Marine Wetland

NWI - Freshwater Forested/Shrub Wetland

Building

Road

500 0 500 Meters

2000 0 2000 Feet

N

Source: National Fish and Wildlife Service, 1982.

Figure 3.6-3

Table 3.6-9

Federally Listed Plants and Animals Potentially Occurring at or Near Onslow Beach, North Carolina

Scientific Name	Common Name	Federal Status
Plants		
Seabeach amaranth	*Amaranthus pumilus*	Threatened
Rough-leaved loosestrife	*Lysimachia asperulaefolia*	Endangered
Birds		
Red-cockaded woodpecker	*Picoides borealis*	Endangered
Piping plover	*Charadrius melodus*	Threatened
Reptiles		
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened
Loggerhead sea turtle	*Caretta caretta*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Smalltooth swordfish	*Pristis pectinata*	Endangered
Atlantic sturgeon	*Acipenser oxyrhinchus*	Candidate
Mammals		
West Indian manatee	*Tricheus manatus*	Endangered
Source: DoN, 2006a.		

*Rough-leaved loosestrife (*Lysimachia asperulaefolia*) typically occurs at the ecotone between savanna or flatwoods and pocosins, inland from the proposed cable termination facility. Plants do best in habitat where shrubby vegetation is kept low by frequent natural or prescribed fires and Camp Lejeune applies prescribed fire at a return treatment interval of two to three years to manage it (DoN, 2006a). Due to the absence of rough-leaved loosestrife in the vicinity of the cable termination facility, there would be no overlap with the proposed landfall site.*

Pondberry, a federally-listed endangered plant, was reported on Camp Lejeune in a single location; however, the presence of pondberry on Camp Lejeune has yet to be confirmed (DoN, 2006a).

Birds

Piping plover have been documented foraging on Onslow Beach during the winter, spring and fall migration periods, and during the nesting season, although to date no nests have been found (DoN, 2006a). Suitable nesting habitat is available and since 2000 bi-weekly shorebird surveys along the accessible portion of Onslow Beach have been conducted. There is no designated critical wintering habitat for the piping plover in the vicinity of Site C (USFWS, 2008a).

The red-cockaded woodpecker makes its home in mature pine forests. Camp Lejeune currently supports 81 active red-cockaded woodpecker clusters (DoN, 2006a). All of these clusters are located in forested areas, inland from the cable termination facility. Due to the absence of red-cockaded woodpeckers in the vicinity of the cable termination facility, there would be no overlap with the proposed landfall site.

Reptiles

The loggerhead and green sea turtles are known to nest on Onslow Beach. Loggerhead and green turtle nesting generally occurs from May through November (USFWS, 2002). Nesting is known to occur on Onslow Beach at an approximate density of 3.5 nests per km (5.6 nests per mi) (USFWS, 2002). Nest density is slightly lower in the central portion of the recreational beach, just north of the proposed cable location. During the nesting season, reproducing females, adult males, as well as juvenile and hatchling sea turtles would be expected to utilize the nearshore areas of Onslow Bay.

As described in North Carolina Administrative Code 15A.03I.0107, the nearshore waters of the Atlantic Ocean roughly adjacent to Camp Lejeune comprise a seasonal (June 1 – August 31) sea turtle sanctuary that extends approximately 1 km (0.6 mi) offshore. Within this area, the use of commercial fishing equipment is prohibited. However, the North Carolina Division of Marine Fisheries (NCDMF), through issuance of proclamations, can modify the gear prohibitions. The sanctuary is intended to protect nesting sea turtles from fisheries-related injury. Military operations or uses are not affected by the sanctuary designation.

Fish

Shortnose sturgeon have not been documented near Onslow Beach and the closest population, estimated at about 50 individuals, is located in the Cape Fear River (NMFS, 1998d). As there are no shortnose sturgeon in the vicinity and as this species typically spends limited time in marine habitats, shortnose sturgeon are considered unlikely to occur in the nearshore areas off the proposed cable landfall site.

Since 1915 there have been only three published records of the smalltooth sawfish in North Carolina waters; one each in 1937, 1963, and 1999 (NMFS, 2006o). Due to the scarcity of this species and their preference for estuarine shallow waters close to shore with muddy and sandy *bottoms, it is considered very unlikely that smalltooth sawfish would occur in the nearshore area off the proposed cable landfall site*

The Atlantic sturgeon has been documented in the Pamlico Sound north of Onslow Beach and the Cape Fear River to the south. Given that Atlantic sturgeon are found in marine habitats, they may potentially be present in nearshore waters off of proposed cable landfall site.

Essential Fish Habitat

EFH associated with the USWTR landfall site at Onslow Beach occur in the AIWW includes: estuarine emergent wetlands (salt marshes), submerged aquatic vegetation, intertidal flats, palustrine emergent and forest wetlands, and the estuarine water column (DoN, 2004a). Nearshore EFH off the coast of North Carolina (Atlantic Ocean) is described in Subchapter 3.2.4 and comprises only a small fraction (0.4 percent) of the corridor area.

Migratory Birds

Onslow Beach is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. Migratory shorebirds feed along the exposed wet sand in wash zones; in the intertidal zone; in the wrack lines; in washover passes; and in mud-, sand-, and algal flats of the beach by probing for invertebrates at or just below the surface. The small sand dunes, debris, and sparse vegetation adjacent to the beach provide shelter from wind and extreme temperatures. Thus, habitat exists at Onslow Beach that supports migratory birds. Migratory water birds observed nesting on Onslow Beach include least tern, Wilson's plover, and American oystercatcher. While not documented, gull-billed tern (<u>Sterna nilotica</u>*), common tern (*<u>Sterna hirundo</u>*), and black skimmer (*<u>Rynchops niger</u>*) could potentially nest in or near the proposed project area.*

Vegetation and Soils

The affected beachfront environment consists primarily of overwash flats, foredunes, primary dunes, and maritime scrub/shrub areas. Vegetation is similar to that of other barrier islands, with dune grasses dominating all areas east of and including the primary dunes, and live oak (<u>Quercus virginiana</u>*), catbriers (*<u>Smilax bona-nox</u> *and* <u>Smilax glauca</u>*), and red bays (*Persea <u>borbonia</u>*) and magnolia (*<u>Magnolia virginiana</u>*) dominating the scrub/shrub areas.*

The soil survey of Onslow County, North Carolina, identifies the soil series at Onslow Beach as Newhan fine sand, dredged (USDA-NRCS, 1992). Coastal erosion is inherent to dynamic barrier islands. The long-term estimated erosion rate through 1992 in the vicinity of the project area ranges from a loss of 0.6 to 1.5 m (2 to 5 ft) per year (NCDCM, 1992). With average annual erosion rates nearing the New River Inlet approaching 6 m (20 ft), the project area falls within a more stable portion of Onslow Beach.

Floodplains

EO 11988 sets forth federal agency responsibilities for reducing the risk of flood loss or damage to personal property, minimizing the impact of flood loss, and restoring the natural and beneficial functions of floodplains. The proposed Site C USWTR landside site lies within the 100-year floodplain. The proposed cable termination facility construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.3.4 Cultural Resources

There is one site at Onslow Beach that is eligible for inclusion in the National Register of Historic Places (DoN, 2004a). The site is a prehistoric Early through Late Woodland occupation and is 1.25 m (4 ft) beneath the sand. This site is near the southwest end of the beach (DoN, 2004a) and would not be impacted by installation of the cable further north along Mockup Road (Figure 2-21).

3.6.3.5 Air Quality

The Clean Air Act (CAA) of 1970 and subsequent amendments specify regulations for control of the nation's air quality. Federal and state ambient air standards have been established for each criterion pollutant. The 1990 amendments to the CAA require federal facility compliance with all applicable substantive and administrative requirements for air pollution control.

The CAA Amendments of 1990 expanded the scope and content of the CAA's conformity provisions by providing a more specific definition of conformity. As stipulated in Section 176(c), conformity is defined as "conformity to the State Implementation Program's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment areas of such standards." The USEPA published final rules on general conformity that apply to federal actions in areas designated nonattainment for any of the criteria pollutants under the CAA (40 CFR Parts 51 and 93) in the November 30, 1993 Federal Register. Since Onslow Beach is located within an attainment area, this rule is not applicable.

3.6.3.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at Onslow Beach.

3.6.4 Site D

The Wallops Flight Facility (WFF) is part of NASA's Goddard Space Flight Center. The facility is comprised of three parts: Wallops Main Base, Wallops Mainland, and Wallops Island. For this action, only the Wallops Island portion of the facility is of concern. It is a barrier island located in Accomack County, Virginia, on the eastern shore of the Delmarva Peninsula. It is *separated from the mainland by Cat Creek and is approximately 11.3 km (7 mi) long, with a width ranging from 1.2 to 2.4 km (0.75 to 1.5 mi) (Figure 3.6-4).*

3.6.4.1 Land Use

The Navy site for the USWTR landside facilities at Wallops Island would be a CTF installed inland of the riprap sea wall shown in Figures 3.6-4 and 3.6-5. The CTF would connect to the AEGIS Combat Systems Center (ACSC) via terrestrial data cable. The new CTF would be a permanent building located on a fenced parcel near the midpoint of the island, with communications towers and commercial phone lines available. The trunk cable would be installed through the SSI in a trench or encapsulated pipe and fed into the CTF.

Operations occurring at the WFF include rocket launchings, balloon launchings, aircraft and drone operation, chaff releases, large- and small-caliber gun firings at barge targets, and the use of lasers and radars.

Wallops Island is situated in a primarily agricultural area that is sparsely populated. Most of the land in the vicinity of Wallops Island that is not being farmed is either woodland or marsh. Wallops Island is zoned as part of the Barrier Island District (Accomack County Zoning Administration, 1973). No residences or farms exist on the island (National Aeronautics and Space Administration [NASA], 1992).

A separate subchapter on coastal zone management has been prepared (Subchapter 3.7). A CCD was also prepared. If the Wallops Island site were selected, the determination would be submitted to, and concurrence sought from, the Virginia Department of Environmental Quality.

3.6.4.2 Socioeconomics

Demographics

Table 3.6-10 presents the ethnic characteristics of Accomack County compared to the state of Virginia. Compared to the state as a whole, the county has a substantially greater population of black or African-Americans (31.4 percent compared to 19.6 percent in the state). The percentages of the other ethnic groups are generally similar, except for the proportionally lower number of Asian and Pacific Islanders in the county (0.3 percent) compared to Virginia (3.7 percent).

Table 3.6-10

Accomack County Ethnic Characteristics

Jurisdiction	% Black	% Hispanic or Latino	% American Indian, Alaskan Native	% Asian, Pacific Islander
Accomack County	31.4	5.4	0.3	0.3
Virginia	19.6	4.7	0.3	3.7
Source: 2000 Census, SF 3.				

As shown in Table 3.6-11, Accomack County has substantially lower household and family income levels than the state as a whole; these county income levels are about 35.2 and 35.7 percent less, respectively, than the Virginia state levels.

Table 3.6-11

Accomack County Income and Poverty Status

Jurisdiction	Median Household Income	Median Family Income	Persons in Poverty[1]		Families in Poverty[1]	
			Persons	%	Families	%
Accomack County	30,250	34,821	6,788	18.0	1,141	13.0
Virginia	46,677	54,169	656,641	9.6	129,890	7.0
Notes: [1] 1999 income below poverty level. Population for whom poverty status is determined. Source: U.S. Census, 2000.						

Environmental Justice

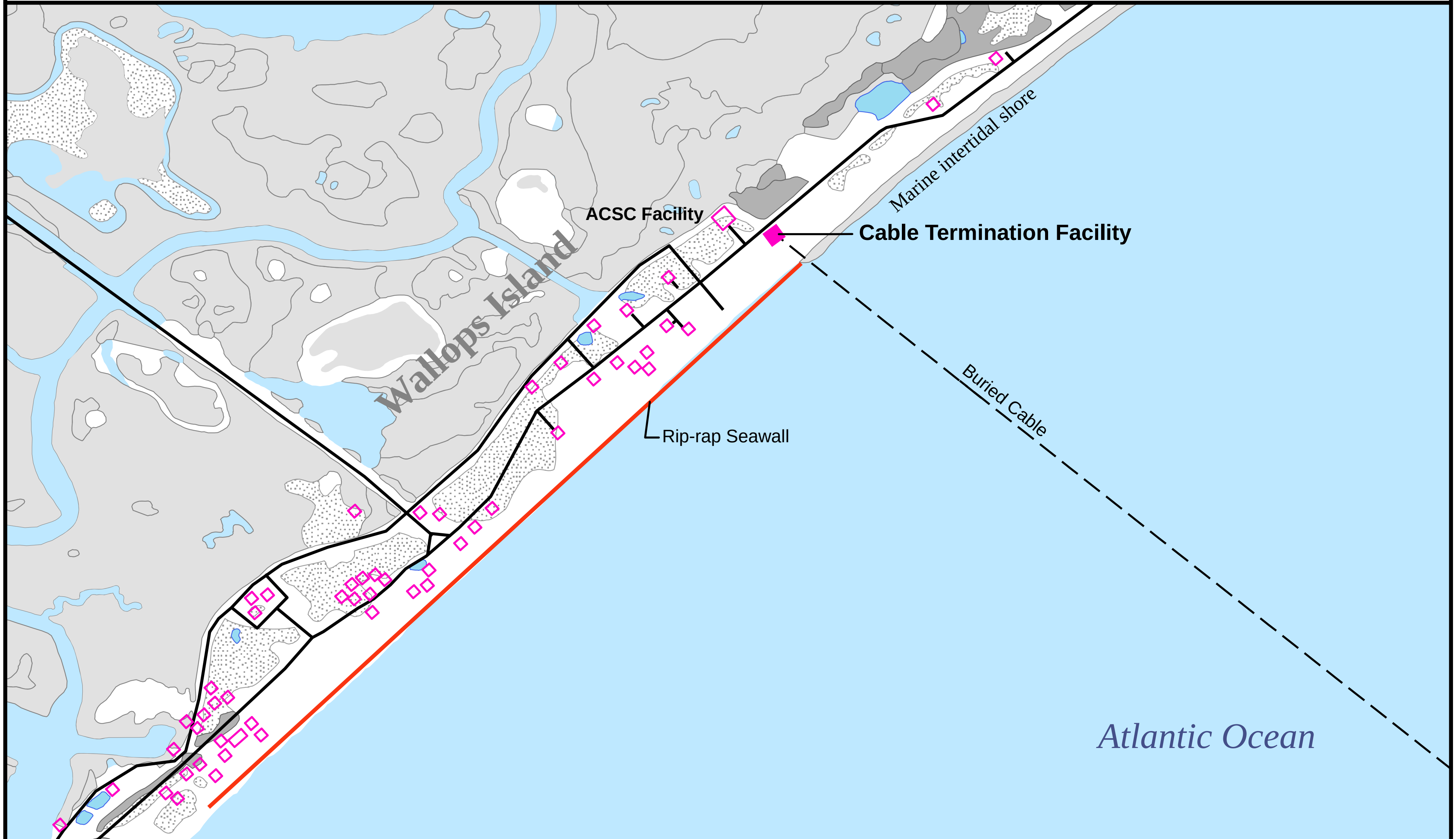
Factors used in determining consistency with EO 12898 focus on the racial, income, and ethnic composition of nearby communities. Ethnic makeup and income of the study area population in the vicinity of the proposed Site D USWTR are described above. The analyses to determine the proposed project's consistency with EOs 12898 and 13045 are presented in Subchapter 4.6.

3.6.4.3 Natural Resources

Navigable Waters

As described for the other sites, the RHA governs the placement of the communications devices and cable for the USWTR in the waters adjacent to Wallops Island. The trenched placement of a cable in the navigable waterway adjacent to the shore will require both a RHA permit and a CWA permit.

Site D National Wetlands Inventory (NWI)



NWI - Estuarine and Marine Wetland
NWI - Freshwater Forested/Scrub Wetland
NWI - Freshwater Emergent Wetland
Building
Road

800 0 800 Meters
2,000 0 2,000 Feet

N

Source: National Fish and Wildlife Service, 1989.

Figure 3.6-4

Site D Piping Plover Management Area

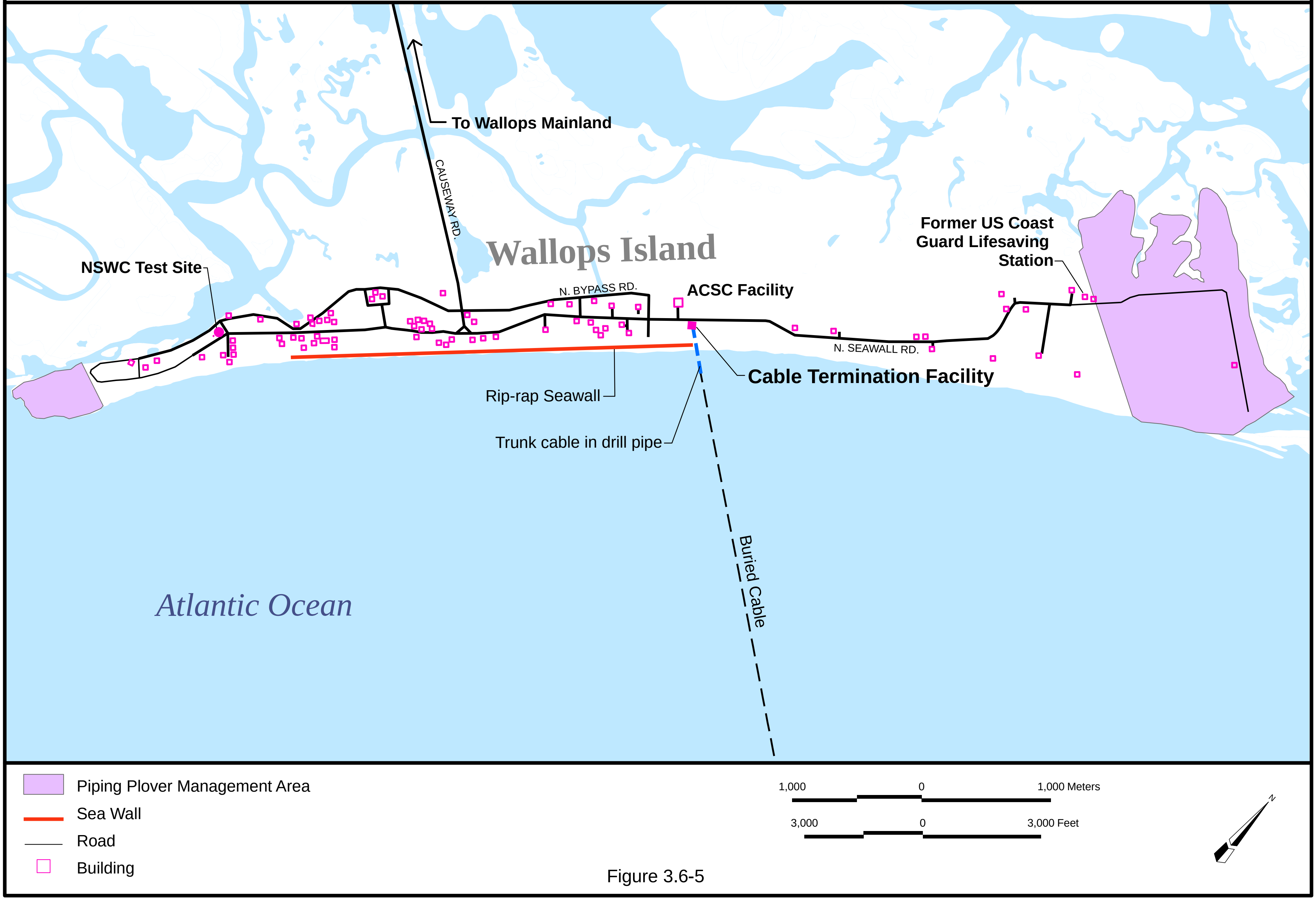


Figure 3.6-5

Wetlands

Extensive marsh wetland systems are found on Wallops Island (URS and EG&G, 2005). The Main Base has tidal and nontidal wetlands along its perimeter in association with water bodies, there are nontidal wetlands in the interior and marsh wetlands on the western edge and along water bodies (URS and EG&G, 2005). Isolated emergent and scrub/shrub wetland communities are depicted on the USFWS NWI maps as occurring in the affected area (PEM1R and PSS3/1R). Figure 3.6-4 presents the NWI information.

Threatened and Endangered Species

Table 3.6-12 lists ESA species potentially found at or near Wallops Island based on a site-wide Environmental Assessment (URS and EG&G, 2005) .

Table 3.6-12

Federally Listed Plants and Animals Potentially Found at or Near Wallops Island

Common Name	Scientific Name	Federal Status
Birds		
Piping plover	*Charadrius melodus*	Threatened
Reptiles		
Loggerhead sea turtle	*Caretta caretta*	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Green sea turtle	*Chelonia mydas*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Hawksbill	*Eretmochelys imbricata*	Endangered
Source: URS and EG&G, 2005.		

Birds

*The federally threatened piping plover (*Charadrius melodus*) and state endangered Wilson's plover use Wallops Island as a breeding area (NASA, 1992; URS and EG&G, 2005). As recommended by the Chincoteague National Refuge, NASA has designated a protected closure area on the southern and northern ends of Wallops Island (Figure 3.6-5). The northern and southern beaches have been closed to vehicle and human traffic during the plover's nesting season (March 15 through September 1) since 1986. Both breeding areas are currently actively managed and monitored by the Chincoteague National Wildlife Refuge and Virginia Department of Game and Inland Fisheries (VDGIF).*

Reptiles

According to the VDGIF, loggerhead and green turtles are known to occur in the vicinity of Wallops Island (VDGIF, 2002). The first documented case of sea turtle nesting on Wallops

Island occurred in July 2002 (Miller 2002) when a loggerhead turtle nested on the north end of Wallops Island (more than 3,000 m [6,600 ft] north of the USWTR landfall site). The nest was ultimately not successful (Miller, 2002). Other sea turtle nests have not been found on Wallops Island; however, sea turtle crawl tracks, a sign of nesting activity, have been seen infrequently (URS and EG&G, 2005). Suitable habitat for sea turtle nesting exists on the northern and southern ends of the island where a natural beach exists. Sea turtle nesting is precluded on the portion of Wallops Island where the riprap seawall has been installed, near the cable termination facility due to an absence of suitable beach seaward of the structure.

Essential Fish Habitat

As described in Subchapter 3.2.4, 3 percent of the corridor area in Site D is designated as nearshore EFH, which includes seagrass beds, salt marshes, and wetlands. The linear path in which the trunk cable will be laid has not been mapped, but may cross nearshore EFH at the USWTR landfall site at Wallops Island.

Migratory Birds

Like the Onslow Beach site, Wallops Island is located within the Atlantic Flyway, a major migration route along the east coast of the U.S. During the fall and spring migratory seasons, large numbers of birds are found in this general corridor. As at Onslow Beach, migratory shorebirds feed on invertebrates on the beach portion of Wallops Island and seek shelter in vegetation adjacent to the beach. During spring and fall migrations, approximately 15 species of shorebirds feed on microscopic plants and animals in the inter-tidal zone. Abundant species include the sanderling, semi-palmated plover, red knot, short billed dowitcher, and dunlin (URS and EG&G, 2005). Nesting shorebird and water bird species that may use habitats near the project area include black skimmer, American oystercatcher, and occasional least, gull-billed, or common terns (Barrier Island Avian Partnership, 1996).

Vegetation and Soils

Approximately 50 percent of Wallops Island is salt marsh, 20 percent is sand and beach, 20 percent is developed, and the remaining 10 percent is covered with shrubs and trees (NASA, 1992). As the southern end of the island is gradually eroding and the northern end of the island is gradually accreting sand, a 1.8- to 3-m (6- to 10-ft) high riprap seawall has been erected along the ocean side of the island in an effort to stabilize it. Figure 3.6-2 depicts the location of the seawall. Vegetation on the island is similar to nearby barrier islands. Vegetative communities within and around the affected environment include scrub/shrub and emergent communities. No forested systems are located between the ACSC and the ocean.

Soils information on the affected environment is listed in Table 3.6-13. All data are derived from the Soil Survey of Accomack County, Virginia (USDA NRCS, 1982).

Table 3.6-13

Soil Series Occurring at the Wallops Island Site

Soil Series			Percent Slope/ Flooding Regime	Hydric Status
Fisherman-Camocca Complex	Depressions & undulating areas associated with dunes	F – moderately well drained C – poorly drained	0 – 6 % slopes Frequently flooded	F – Non-hydric C – Hydric
Camocca fine sand	Depressions & flats between dunes	Poorly drained	0 – 2 % slopes Frequently flooded	Hydric
Assateague fine sand	Back slopes & faces of dunes	Excessively drained	2 – 35 % slopes Rarely flooded	Non-hydric
Beaches	Beaches	–	1 – 5 % slopes	Non-hydric
Source: USDA NRCS, 1982; URS and EG&G, 2005.				

Floodplain Management

As with the other sites, the proposed Wallops Island USWTR landside site lies within the 100-year floodplain. The proposed CTF construction and burial of the trunk cable are not likely to further exacerbate flooding.

3.6.4.4 Cultural Resources

A Cultural Resources Assessment of Wallops Flight Facility was prepared in 2003 (URS and EG&G, 2005). Two historic sites were identified on Wallops Island. No buildings at Wallops Island are currently listed in the Virginia Department of Historic Resources' (VDHR) inventory of historic properties. Likewise, none of the buildings, structures or facilities is listed on the National Register of Historic Places, or is recognized as a National Historic Landmark. The Virginia Research Center for Archaeology (VRCA) performed a preliminary archaeological survey of the property where the ACSC now exists, with negative findings The VRCA considers Wallops Island to be low in potential for historical archeological resources, but to have good potential for prehistoric artifacts; however, no archaeological sites have ever been reported on the island. In addition, the VDHR noted that many of the areas with moderate to high archaeological potential are unlikely to be disturbed by construction or site use. (URS and EG&G, 2005).

3.6.4.5 Air Quality

As with Site C, the Wallops Island site occurs within an area that is in attainment for the criteria pollutants listed under the CAA. As such, the final rule on general conformity that applies to federal actions in areas designated nonattainment is not applicable.

3.6.4.6 Hazardous Materials

There are no known areas of hazardous waste contamination at the site of the proposed USWTR landside facility at Wallops Island. There is a permitted RCRA Subpart X (open burn) unit at the southern end of Wallops Island. The Environmental Office at the Wallops Flight Facility manages hazardous waste generation, including inspection, onsite transportation, storage, and shipment of all hazardous waste and would be consulted to ensure that no contamination exists at the cable termination facility site.

3.7 Coastal Zone Management

The coastal zone is rich in natural, commercial, recreational, ecological, industrial, and aesthetic resources. As such, it is protected by legislation for the effective management of its resources. The Coastal Zone Management Act (CZMA) of 1972 (16 USC § 1451, et seq., as amended) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in the coastal zone. This includes the protection of natural resources and the management of coastal development.

The CZMA establishes national policy to protect resources in the coastal zone. CZMA policy is implemented via NOAA-approved coastal management programs. Federal lands are excluded from the jurisdiction of such approved coastal management programs. The CZMA and its implementing regulations, however, provide that federal agencies must determine if it is reasonably foreseeable that their proposed actions, whether inside or outside of a state's coastal zone, will directly or indirectly affect any land or water use or natural resource within that coastal zone. The CZMA requires that federal activities affecting any coastal use or resource of a state must be consistent to the maximum extent practicable with the enforceable policies of the state's NOAA-approved coastal management plan.

The landward boundaries of the coastal zone vary by state, reflecting both the natural and built environments. The seaward boundaries generally extend to the outer limits of the jurisdiction of the state, but not more than 5.6 km (3 NM) into the Atlantic Ocean.

3.7.1 Site A

NOAA approved the Florida Coastal Management Program (FCMP), the state of Florida's federally approved management program, in 1981. The state of Florida's federal consistency review is conducted jointly by its FCMP member agencies and is coordinated by the Florida Department of Community Affairs, which is the lead coastal agency pursuant to Section 306(c) of the CZMA. The state has limited its federal consistency review of federally licensed and permitted activities to the federal licenses or permits specified in Section 380.23(3)(c) of the Florida Code requested for activities located in, or seaward of, one of the state's 35 coastal counties (FCMP, 2004).

The FCMP consists of a network of 23 Florida statutes administered by 11 state agencies and four of the five water management districts. The program is designed to ensure the wise use and protection of the state's water, cultural, historic, and biological resources; to minimize the state's vulnerability to coastal hazards; to ensure compliance with the state's growth management laws; to protect the state's transportation system; and to protect the state's proprietary interest as the owner of sovereign submerged lands (FCMP, 2004).

Of the 23 Florida statues implemented by the FCMP, the following subject areas are most relevant to the proposed USWTR landside facilities at Naval Station Mayport:

- *Growth policy, county and municipal planning, and land development regulation*
- *State and regional planning*
- *Land and water management*
- *State lands*
- *Historical resources*
- *Conservation or recreation*
- *Saltwater fisheries*
- *Wildlife*
- *Soil and water conservation environmental control*

The remaining enforceable statues have little or no relevance to the proposed USWTR landside facilities. These statutes address the following areas:

- *Multipurpose outdoor recreation and land acquisition, management, and conservation*
- *Commercial development and capital improvements*
- *Emergency management*
- *State parks and preserves*
- *Beach and shore preservation*
- *Transportation administration*
- *Recreational trails system*
- *Transportation finance and planning*
- *Water resources*
- *Pollutant discharge prevention and removal*
- *Energy resources*
- *Public health, general provisions*
- *Mosquito control*

Naval Station Mayport falls within the city of Jacksonville, which is a participating agency in the FCMP. In the Conservation/Coastal Element of its 2010 Comprehensive Plan, the city outlines 11 goals with supporting policies that direct the management and conservation of coastal resources (City of Jacksonville Planning and Development Department, 2003). The city addresses the following resource areas:

- *Air quality*
- *Water quality*
- *Native ecological communities*
- *Wetlands conservation*
- *Unique or sensitive environments*

- *Sandy beaches and shorelines*
- *Coastal storm-related public safety and health*
- *Historical resources*
- *Level-of-service standards*
- *Siting and operation of boat facilities*
- *Compatible development*

3.7.2 Site B

The South Carolina Coastal Management Program (SCCMP) was approved by NOAA in 1979. The primary authority for the SCCMP is the 1977 Coastal Tidelands and Wetlands Act and the program's lead agency is the Office of Ocean and Coastal Resource Management (OCRM) of the South Carolina Department of Health and Environmental Control (SCDHEC). The South Carolina coastal zone comprises the coastal waters and submerged lands seaward to the state's jurisdictional limits, and the lands and waters of the eight coastal counties; specifically, Beaufort, Berkeley, Charleston, Colleton, Dorchester, Horry, Jasper, and Georgetown counties (SCDHEC, 2007).

OCRM has direct permitting authority over the critical areas of the coast, defined as all coastal waters, tidelands, beaches, and oceanfront sand dune systems. Critical area policies under the SCCMP have been designated by OCRM in the following categories, with those policies relevant to the proposed project in bold (SCDHEC, 2006):

- ***General guidelines for beaches and the beach/dune system***
- *Abandoned vessels and structures*
- ***Specific project standards for tidelands and coastal waters, with relevant policies pertaining to cables, pipelines, and transmission lines; and dredging and filling***
- ***Specific project standards for beaches and dunes***

The office also has indirect management authority of coastal resources throughout the coastal zone; here the OCRM has authority to review any project requiring a state permit, a federal permit or license, or federal funding, as well as direct federal activities to determine if the project or activity is consistent with the policies and procedures of the SCCMP. The SCCMP identifies resource policies for each of the following "activities subject to management," with those relevant to the proposed project in bold (SCDHEC, 1995):

- *Residential development*
- *Transportation facilities*
  - *Ports*
  - ***Roads and highways (including bridges and transit facilities)***
  - *Airports*

  - *Railways*
  - ***Parking facilities***
- *Coastal industries*
  - *Agriculture*
  - *Forestry (silviculture)*
  - *Mineral extraction*
  - *Manufacturing*
  - *Fish and seafood processing*
  - *Aquaculture*
- *Commercial development*
- *Recreation and tourism*
  - ***Parks***
  - *Commercial recreation*
- *Marine related facilities*
  - *Marinas*
  - *Boat ramps*
  - *Docks and piers*
  - *Dock master plans*
- *Wildlife and fisheries management*
  - ***Wildlife and fisheries management***
  - *Artificial reefs*
  - *Impoundments*
- *Dredging*
  - ***Dredging***
  - *Dredged material disposal*
  - *Underwater salvage*
- *Public services and facilities*
  - *Sewage treatment*
  - *Solid waste disposal*
  - *Public/Quasi-public buildings*
  - *Dams and reservoirs*
  - *Water supply*
- *Erosion control*
- *Energy and energy-related facilities*
- *Activities in areas of special resource significance*
  - *Barrier islands*
  - *Dune areas (outside the critical areas)*
  - ***Navigation channels***
  - ***Public open space***
  - *Wetlands (outside the critical areas)*
- *Stormwater management guidelines*

  - ***Stormwater runoff storage requirements***
  - ***Project size requiring stormwater management permits***
  - *Stormwater management requirements for bridge runoff*
  - *Golf courses adjacent to receiving water bodies*
  - *Mines and landfills*
  - ***Notice of approval***
- *Mitigation guidelines*
  - ***Types of wetland impacts which may require mitigation***
  - ***Types and requirements of mitigation***
  - ***Monitoring and compliance***
  - ***Notice of approval.***

3.7.3 Site C

The North Carolina Coastal Area Management Act (CAMA) of 1974 was passed in accordance with the federal CZMA. Approved by NOAA in September 1978, it established a cooperative program of coastal area management between local and state governments. General coastal area policy guidelines issued by North Carolina are listed below with those guidelines relevant to the proposed project in bold:

- ***Shoreline erosion policies***
- ***Shorefront access policies***
- *Coastal energy policies*
- *Post-disaster policies*
- *Floating structure policies*
- ***Mitigation policies***
- ***Coastal water quality policies***
- ***Policies on use of coastal airspace***
- *Policies on water- and wetland-based target areas for military training areas*
- *Policies on beneficial use and availability of materials resulting from the excavation or maintenance of navigational channels*
- *Policies on ocean mining.*

While local governments have the initiative for planning under the CAMA, the state has designated areas of environmental concern in the following four broad categories:

- *Estuarine and ocean systems*
- *Ocean hazard areas*
- *Public water supplies*
- *Natural and cultural resource areas.*

Each of these areas of environmental concern is relevant in the evaluation of the proposed project and is included in coastal zone consistency analysis and determination.

The CAMA required local governments in each of the 20 coastal counties in the state to prepare and implement a land use plan and ordinances for its enforcement. Upon approval by the North Carolina Coastal Resources Commission, the plan becomes part of the North Carolina Coastal Management Plan.

Coastal zone management policies adopted in each plan must be consistent with established state and federal policies. Specifically, policy statements are required on resource protection; resource production and management; economic and community development; continuing public participation; and storm hazard mitigation, post-disaster recovery, and evacuation plans.

Onslow County recently updated its land use plan (Onslow County, 2004). Currently, zoning controls are applicable to only one special area, Golden Acres in Stump Sound Township. However, the 2004 Citizen's Comprehensive Plan for Onslow County makes recommendations regarding the need for more comprehensive zoning and general guidance of development patterns. The citizen committees stressed the importance of open space, farm preservation, and the management of water-oriented activities among other issues relevant to growth in coastal areas (Onslow County, 2004).

3.7.4 Site D

The Commonwealth of Virginia has developed and implemented a federally approved Coastal Resources Management Program (CRMP) describing current coastal legislation and enforceable policies. Virginia's CRMP is a networked program with several agencies administering the enforceable policies. These policies, with those relevant to the proposed project in bold, are listed as follows:

- ***Fisheries management***
- ***Subaqueous lands management***
- ***Wetlands management***
- ***Dunes management***
- ***Non-point source pollution control***
- *Point source pollution control*
- *Shoreline sanitation*
- *Air pollution control*
- ***Coastal lands management.***

Advisory policies for geographic areas of particular concern recommended for consideration by Virginia include coastal natural resource areas, coastal natural hazard areas, and waterfront development areas.

Coastal lands management is addressed via the Virginia Chesapeake Bay Preservation Act and the Chesapeake Bay Preservation Area Designation and Management Regulations, which establish a cooperative program between state and local governments to reduce nonpoint source pollution. The objectives of the program are to improve water quality in Chesapeake Bay and its tributaries, and promote sound land use planning and management practices on environmentally sensitive lands, known as Chesapeake Bay preservation areas (CBPAs). CBPAs are classified into two categories:

- ***Resource protection areas (RPAs)**, within which development is limited to water-dependent uses and redevelopment. RPAs include tidal wetlands, nontidal wetlands connected by surface flow and contiguous to tidal wetlands or perennial streams, tidal shores, and 30-m (100-ft) vegetated buffers adjacent to these features and along both sides of perennial streams (riparian buffers).*

- ***Resource management areas (RMAs)**, where development is permitted in accordance with performance criteria contained in the regulations and incorporated in local ordinances. RMAs include floodplains, highly erodible soils (including steep slopes), highly permeable soils, nontidal wetlands not included in RPAs, and any other lands the locality deems necessary to protect the quality of state waters.*

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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 km^2 (500

NM^2) area. The total seafloor area covered by these components would be approximately 3,300 m^2 (31,700 ft^2), 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 m^2 (8,841,200 ft^2) area of impact and burial of the internode cables would result in an additional 5,550,000 m^2 (59,739,700 ft^2) 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 m^2 (50 ft^2) 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 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 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 REXTORP 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 cm^2 (176 in^2), or 0.11 m^2 (1.2 ft^2). This number, multiplied by 3,000 (the estimated number of sonobuoys used per year), provides an estimated overall sonobuoy coverage of 341 m^2 (3,673 ft^2). As the sea floor of the USWTR would encompass an area of 1,713 km^2 (500 NM^2), 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 m^2 (1356 ft^2) 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 m^2 (495 ft^2). 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 km^2 (500 NM^2) 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 (H_2O), 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.

Ocean Water Quality Criteria
Federal Metals Limits (µg/L or ppb)

	Acute (1 hour)	Chronic (96 hours)
Lead	210	8.1
Copper	4.8	3.1
Silver	1.9	-

Source: USEPA, 1986; USEPA, 2006.

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 (Pb^0) 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 (SO_2), lithium metal, carbon, acetonitrile, and lithium bromide (LiBr). During battery operation, the lithium reacts with the sulfur dioxide and forms lithium dioxide (LiO_2). 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 ($PbCl^2$), lead carbonate ($PbCO^3$), and lead dioxide (PbO^2), 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 ($LiSO_2$) 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 (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-km^2 (500-NM^2) area. The total seafloor area covered by these components would be approximately 3,300 m^2 (31,700 ft^2).

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 m^2 (9,903,000 ft^2) area of impact and the internode cables would result in an additional 5,550,000 m^2 (59,739,700 ft^2) 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

Metal	Saltwater CMC (ug/L) ppb	Saltwater CCC (ug/L) ppb	Initial Concentrations within 1 m^3 from battery (ug/L) ppb
Copper	4.8	3.1	0.015
Lead	210	8.1	1.1
Silver	1.9		0.001

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.

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 m^2 (9,903,000 ft^2) for the buried trunk cable and 5,550,000 m^2 (59,739,700 ft^2) 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 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 935 km^2 (273 NM^2) 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 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 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 km^2 (1.6 NM^2) 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 km^2) 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 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. 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 km^2 (2.0 NM^2). 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 0.93m^2 (10 ft^2). 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 km^2) 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 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 1,285 km^2 (375 NM^2) 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 km^2 (0.14 NM^2) 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 km^2 [195 NM^2]) has been surveyed for the presence of live/hard bottom. The total area of known live/hard bottom located within the range is 186 km^2 (54 NM^2), which represents 13 percent of the range. In addition, approximately 270 km^2 (79 NM^2) 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 km^2 (1.6 NM^2) 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 km^2) 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/manmade 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 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 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 corridor (1,021 km^2 [298 NM^2) 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 km^2 (31 NM^2) and in the trunk cable corridor is 204 km^2 (59 NM^2).

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 km^2 (1.6 NM^2), 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 km^2 (0.13 NM^2) 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 km^2) 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 km^2 (2.0 NM^2) with approximately 2.2 km^2 (0.6 NM^2) 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 km^2 [464 NM^2]) 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 km^2 [0.02 NM^2]) 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 surfacing 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 cm^2 (176 in^2), or 0.11 m^2 (1.2 ft^2). This number, multiplied by 3,000 (the estimated number of sonobuoys used per year) provides an estimated overall sonobuoy coverage of 330 m^2 (3,552 ft^2). 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

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; Cotraneo, 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 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 m^2 (4 to 9 ft^2). 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 94.1percent 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-Alantic 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, 1989). 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

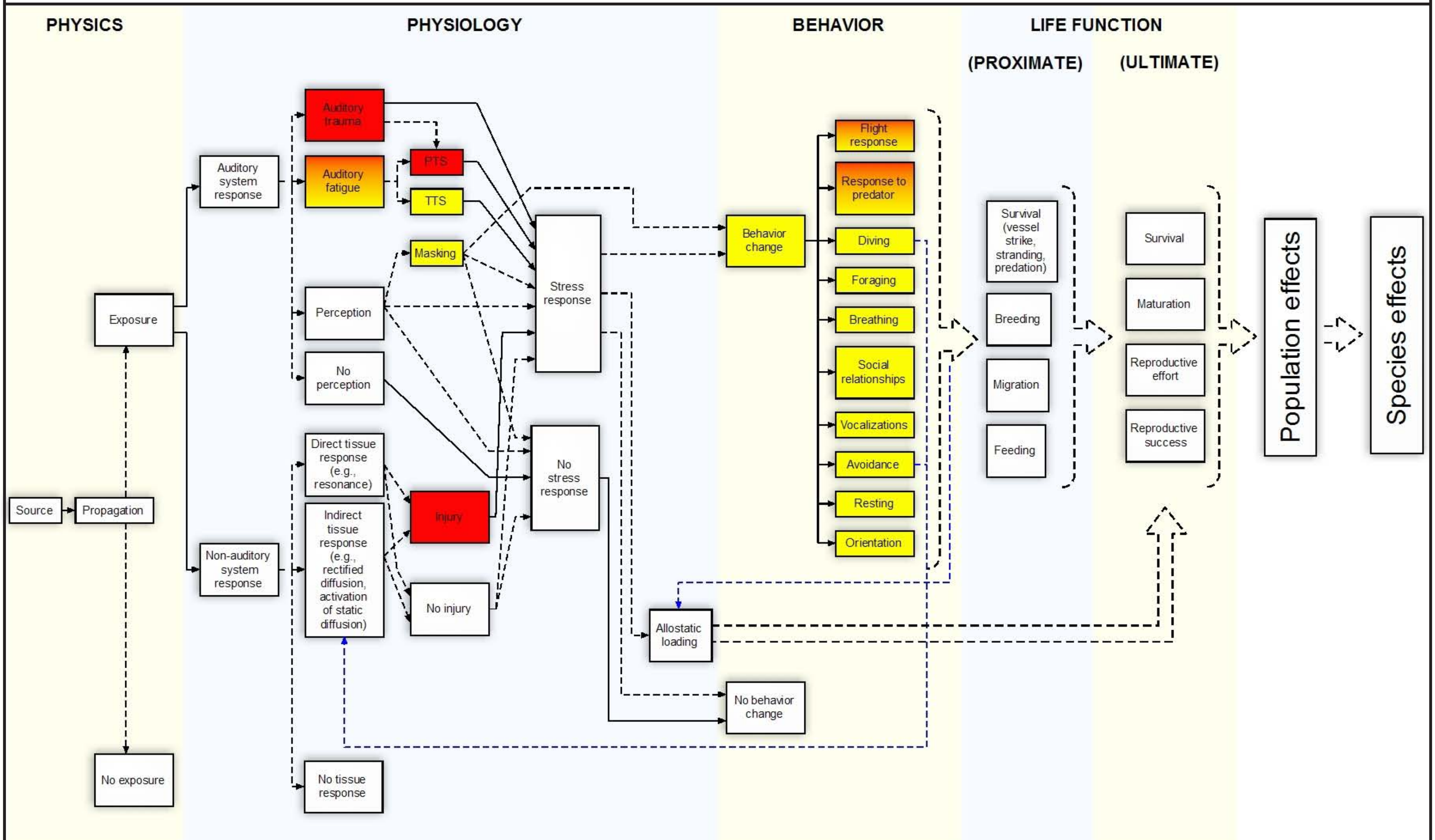

Figure 4.3-1

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 water gun 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.

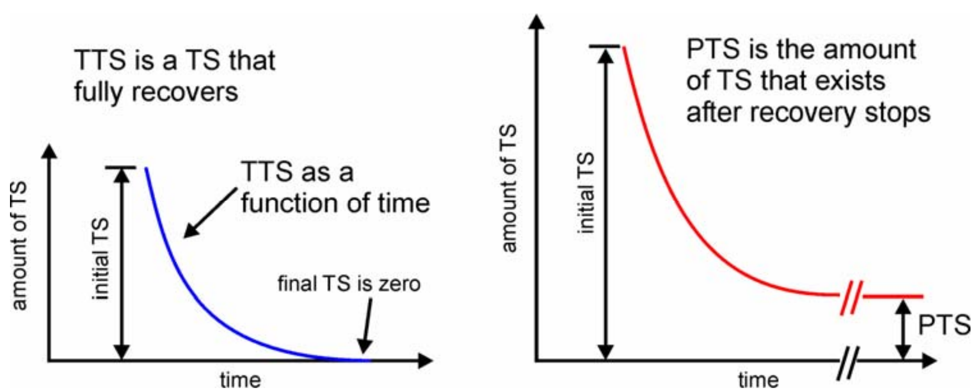

Figure 4.3-2.

Two Hypothetical Threshold Shifts

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, 2004). 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 μPa^2-s, the estimate for onset-PTS would be 215 dB re 1 μPa^2-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 μPa^2-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 *ex vivo* supersaturated (bovine) tissues suggested that for a 37 kHz signal, a sound exposure of ~215 dB re 1 μPa 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 μPa, 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 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.

4.3.1.3.2.3 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., adrenalines 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).

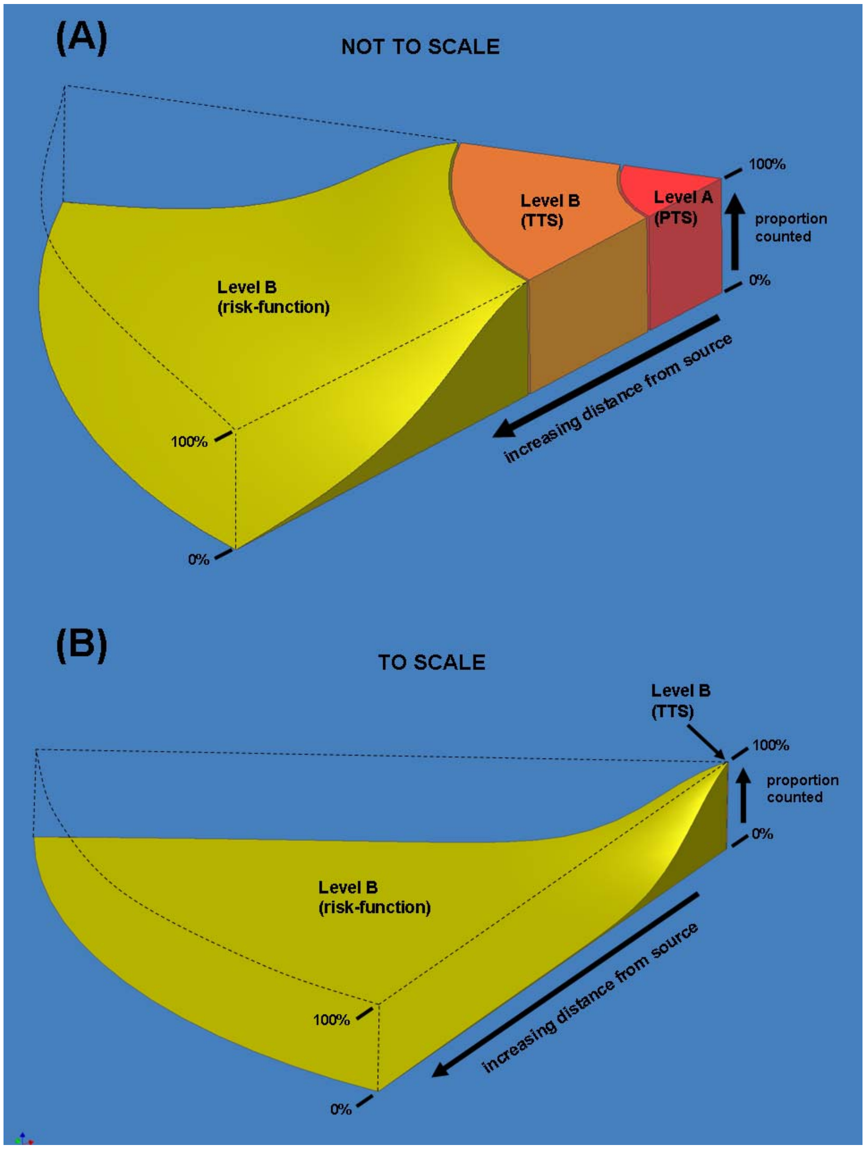

Figure 4.3-3

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 μPa^2-s received SEL for TTS

215 dB re 1 μPa^2-s received SEL for PTS

A marine mammal predicted to receive a sound exposure with SEL of 215 dB re 1 μPa^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 μPa^2-s but less than 215 dB re 1 μPa^2-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 μPa^2-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 μPa^2-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 4.3.1.3.1.3). 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 μPa^2-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:

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

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 µPa^2-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 µPa^2-s reference point differs from the threshold of 195 dB re 1 µPa^2-s used for TTS in this OEIS/EIS. The 192 dB re 1 µPa^2-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 µPa^2-s was used to protect against misinterpretation of the sparse data set available. The 192 dB re 1 µPa^2-s value was reduced to 182 dB re 1 µPa^2-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 µPa^2-s), instead of the minimum of 192 dB re 1 µPa^2-s. The threshold is applied in this OEIS/EIS as an "all-or-nothing" value, where 100% of animals receiving SEL $\geq$ 195 dB re 1 µPa^2-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; Southhall 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).

$$R = \frac{1 - \left(\frac{L - B}{K} \right)^{-A}}{1 - \left(\frac{L - B}{K} \right)^{-2A}}$$

Where: R = risk (0 – 1.0);
L = 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., 2002). 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 μPa2-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.

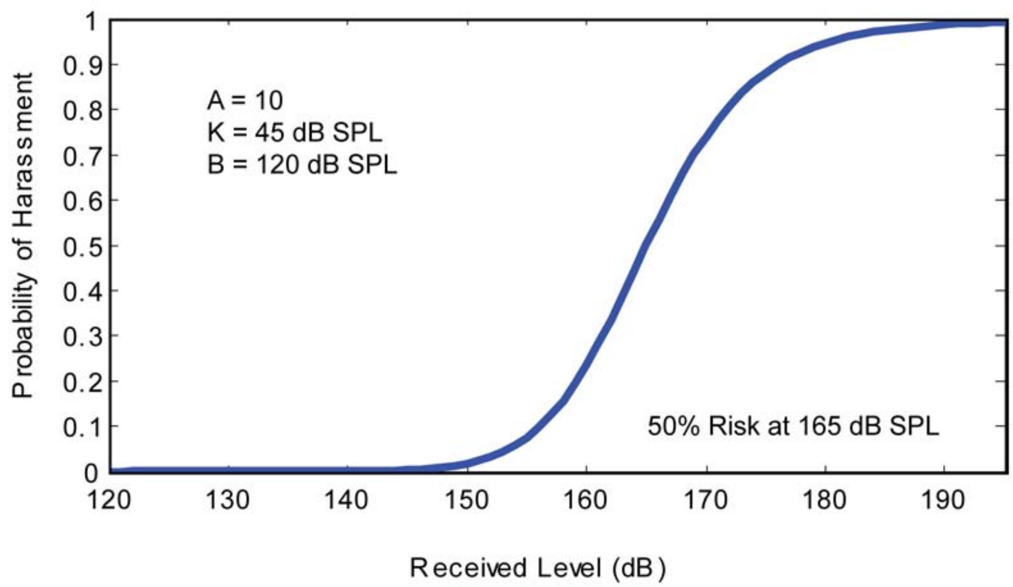

Figure 4.3-4

Risk Function Curve for Odontocetes (Toothed Whales, excluding harbor porpoises) and Pinnipeds

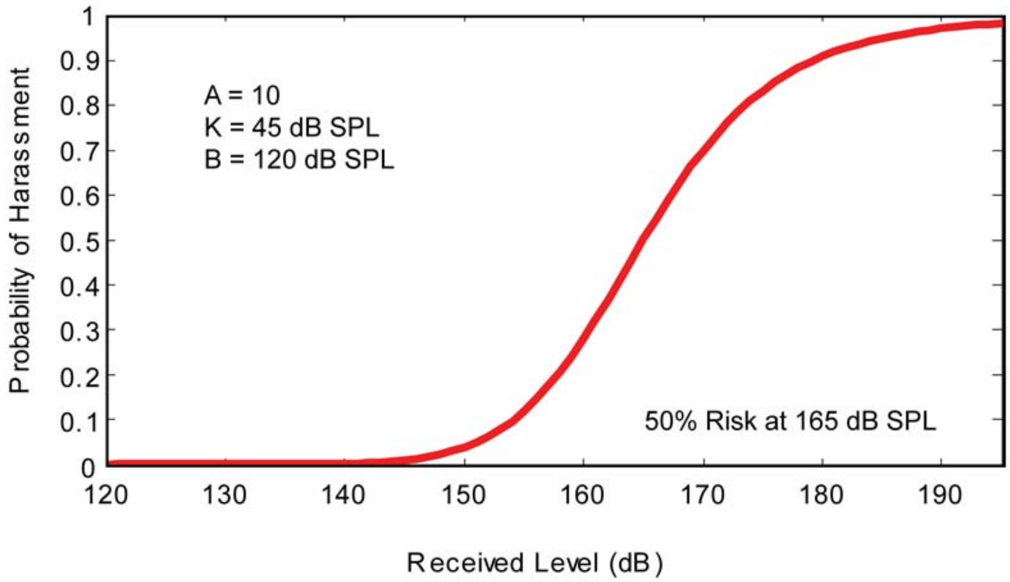

Figure 4.3-5

Risk Function Curve for Mysticetes (Baleen Whales)

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

The Percentage of Exposures Exhibiting Behavioral Harassments

Received Level	**Distance at Which Levels Occur Within Jacksonville Study Area**	**Percent of Harassments Occurring at Given Levels**
120>=SPL<130	147 km - 107 km	0%
130>=SPL<140	107 km - 71 km	<1%
140>=SPL<150	71 km - 43.8 km	4%
150>= SPL <160	43.8 km - 20 km	34%
160>= SPL <170	20 km - 6.2 km	50%
170>= SPL <180	6.2 km - 1.1 km	11%
180>= SPL <190	1.1 km - 0.2 km	<1%
190>= SPL <195	214 m - 103 m	0%
PTS (215 dB SEL)	10 m	0%

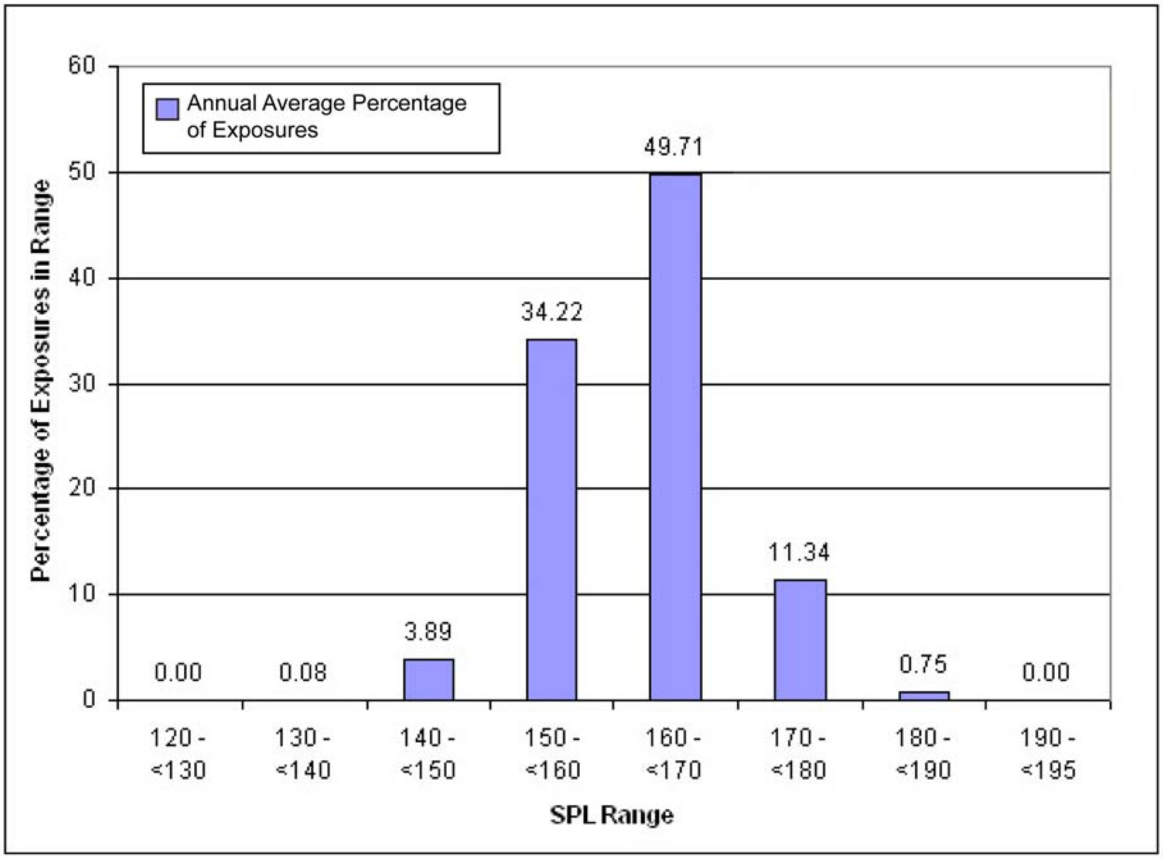

Figure 4.3-6

The Percentage of Exposures Exhibiting Behavioral Harassments
Resulting from the Risk Function

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

Navy Protocols Providing for Accurate Modeling Quantification of Marine Mammal Exposures

Historical Data	Sonar Positional Reporting System (SPORTS)	As USTWR will be a new training range, historical usage of the area was not applicable.
Acoustic Parameters	AN/SQS-53 and AN/SQS-56	The AN/SQS-53 and the AN/SQS-56 active sonar sources separately to account for the differences in source level, frequency, and exposure effects.
	Submarine Sonar	Submarine active sonar use is included in effects analysis calculations.
Post Modeling Analysis	Land Shadow	Land shadow was determined to not affect the modeling results and was not included because of the distance from shore of the site location.
	Multiple Ships	The effect of multiple ships was not considered because of the limited occurrences where two or more ships are using active sonar simultaneously in USWTR scenarios, and therefore, the effect to modeled exposure numbers is negligible.
	Multiple Exposures	Accurate accounting for USWTR training events within the course of one day or a discreet continuous sonar event: • Scenario 1 – 2 hours • Scenario 2 – 3 hours • Scenario 3 – 6 hours • Scenario 4 – 3 hours

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%).

- Ping repetition rate is about 25 seconds.

- Ship speed is approximately 10 knots (18.52 km/h).

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 4.3-3

Other Acoustic Sources not Considered Further

Acoustic Source	Comment
Underwater mobile sound communications (UQC) (surface ships, submarines, sensor nodes)	Source levels 188 – 193 dB re 1 μPa between 8 – 11 kHz.
Fathometer	Source frequency: 12 kHz. System is not unique to military and operates identically to any commercially available bottom sounder.
Mk 30 Target	Source level is not problematic but is classified.
Mk 39 EMATT	Source level is not problematic but is classified.
Pinger	Operational equipment used primarily for submarine safety

Table 4.3-4 details the acoustic sources modeled in this analysis:

Table 4.3-4

Acoustic Sources Considered in Analysis

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

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

Acoustic Sources Used by Training Scenario and Operational Duty Cycles

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

- **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 1μPa^2 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 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

Acoustic Effect Analysis Modeling Flow Diagram

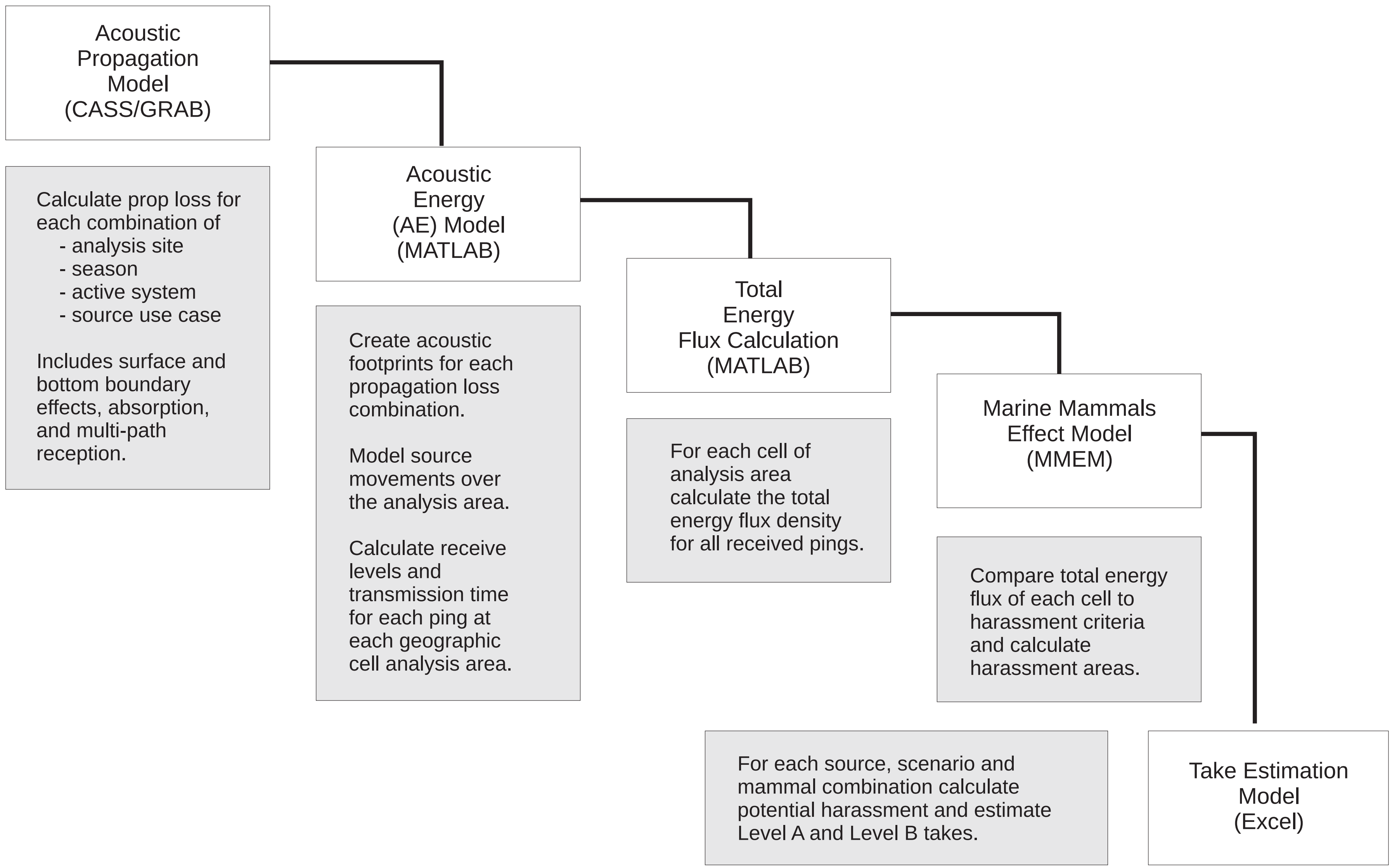

Figure 4.3-7

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 4.3-6

Level A Harassment Range Example

Source Level (dB re μPa @ 1 m)	Ping Length (s)	Total SEL (dB re 1 μPa^2 s)	Level A Threshold (dB re 1 μPa^2 s)	Allowable Spreading Loss (dB)	Distance to Reach Level A Threshold (20 Log R) m
215	1	215.00	215	0.00	1.00
220	1	220.00	215	5.00	1.8
225	1	225.00	215	10.00	3.1
230	1	230.00	215	15.00	5.6

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.

CASS/GRAB Propagation Loss Calculations

Energy received at a particular point from multiple ray paths is summed to calculate the total received energy for that point.

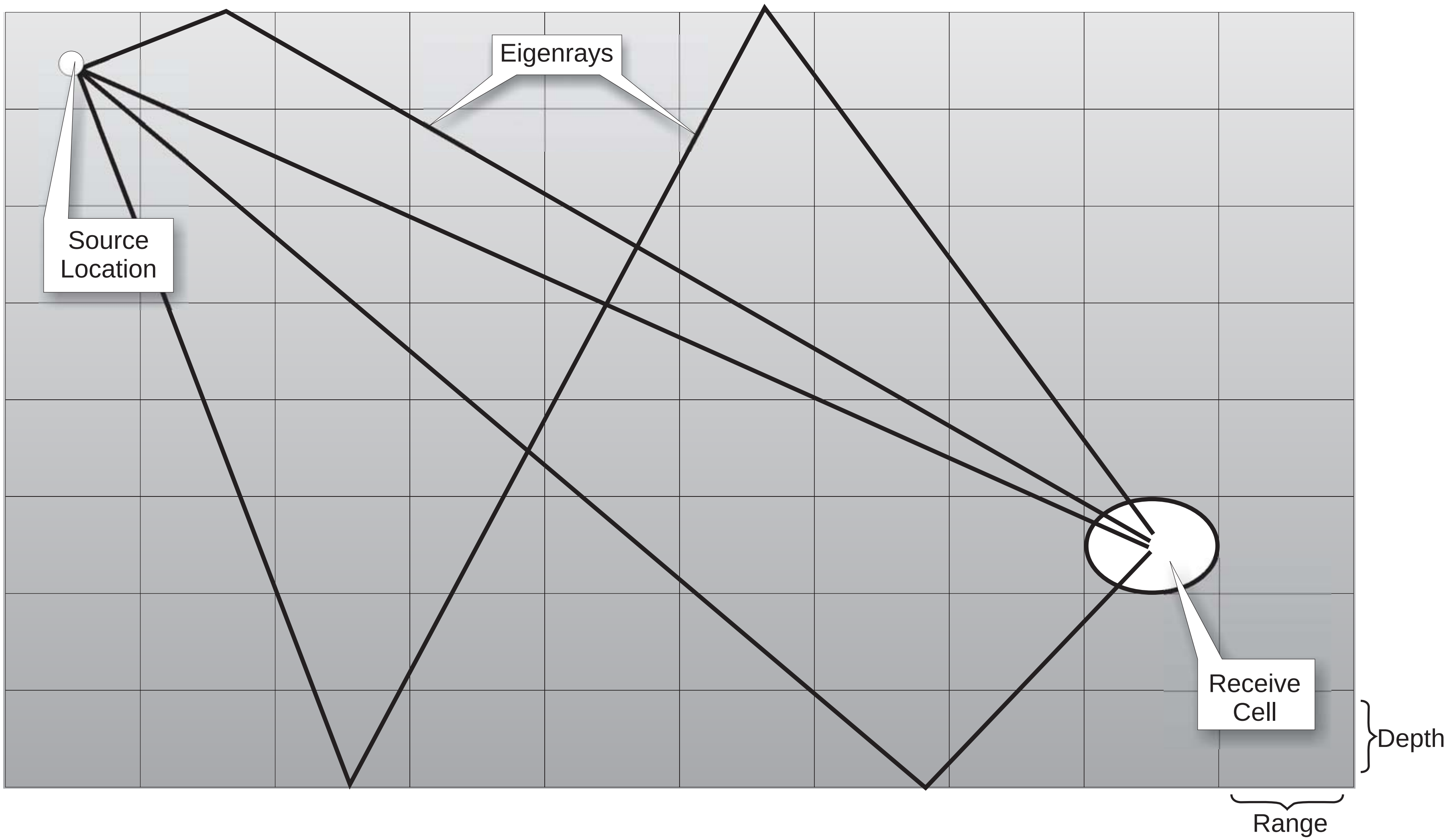

Figure 4.3-8

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 km^2 (0.0001822 NM^2).

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:

$$SEL = SPL + 10\log_{10} T$$

where SEL has units of dB re 1 μPa^2-s, SPL has units of dB re 1 µPa, and T is in seconds.

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 µPa^2-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 km^2 (0.0001822 NM^2). 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:

$$R(L) = 1 / \{1 + [K / (L - B)] ^\wedge A\}$$

where,

R = risk (0 – 1.0)
L = received level (RL; in units of dB)

Relative Received Level vs Range

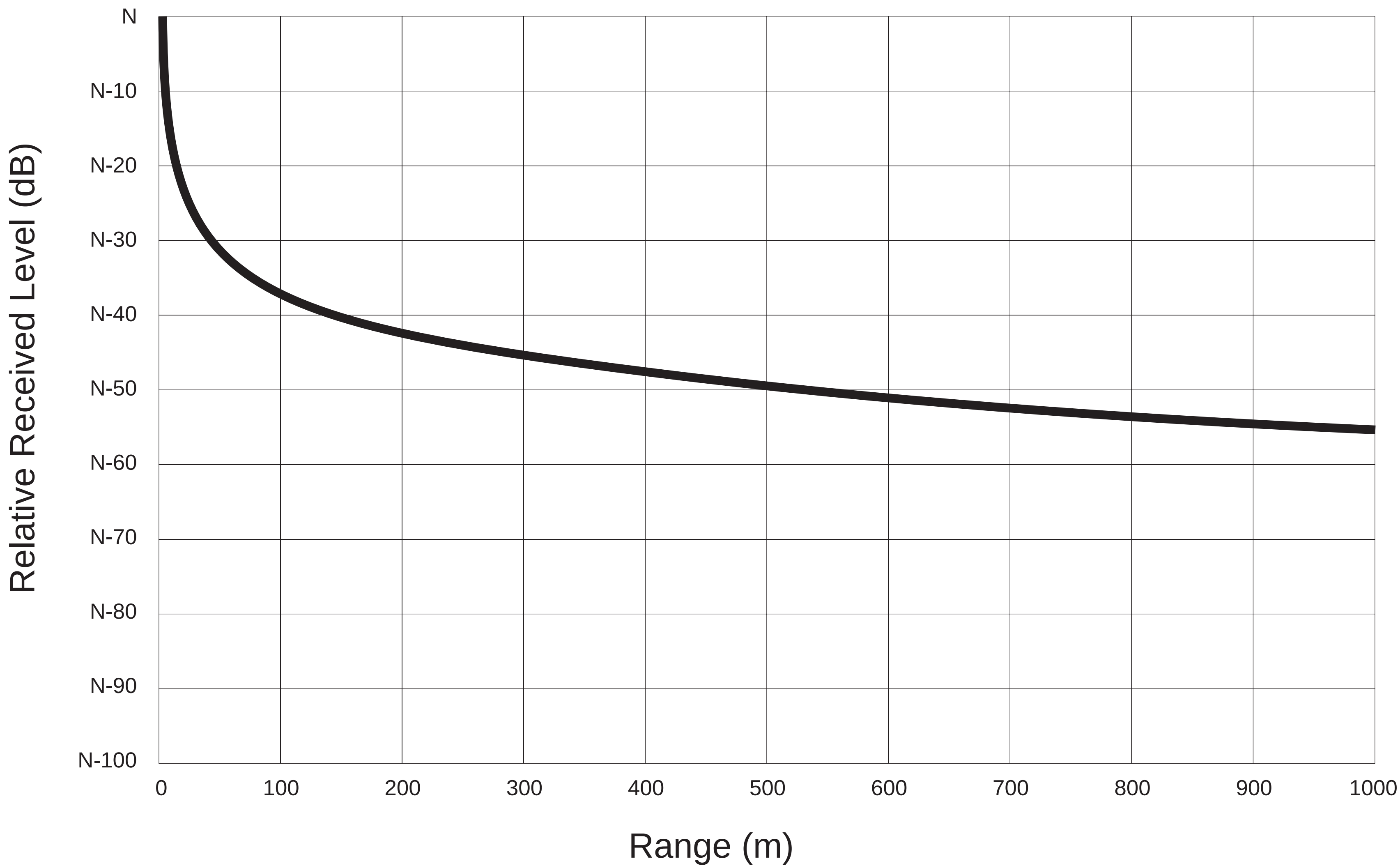

Figure 4.3-9

Bearing Angles for CASS

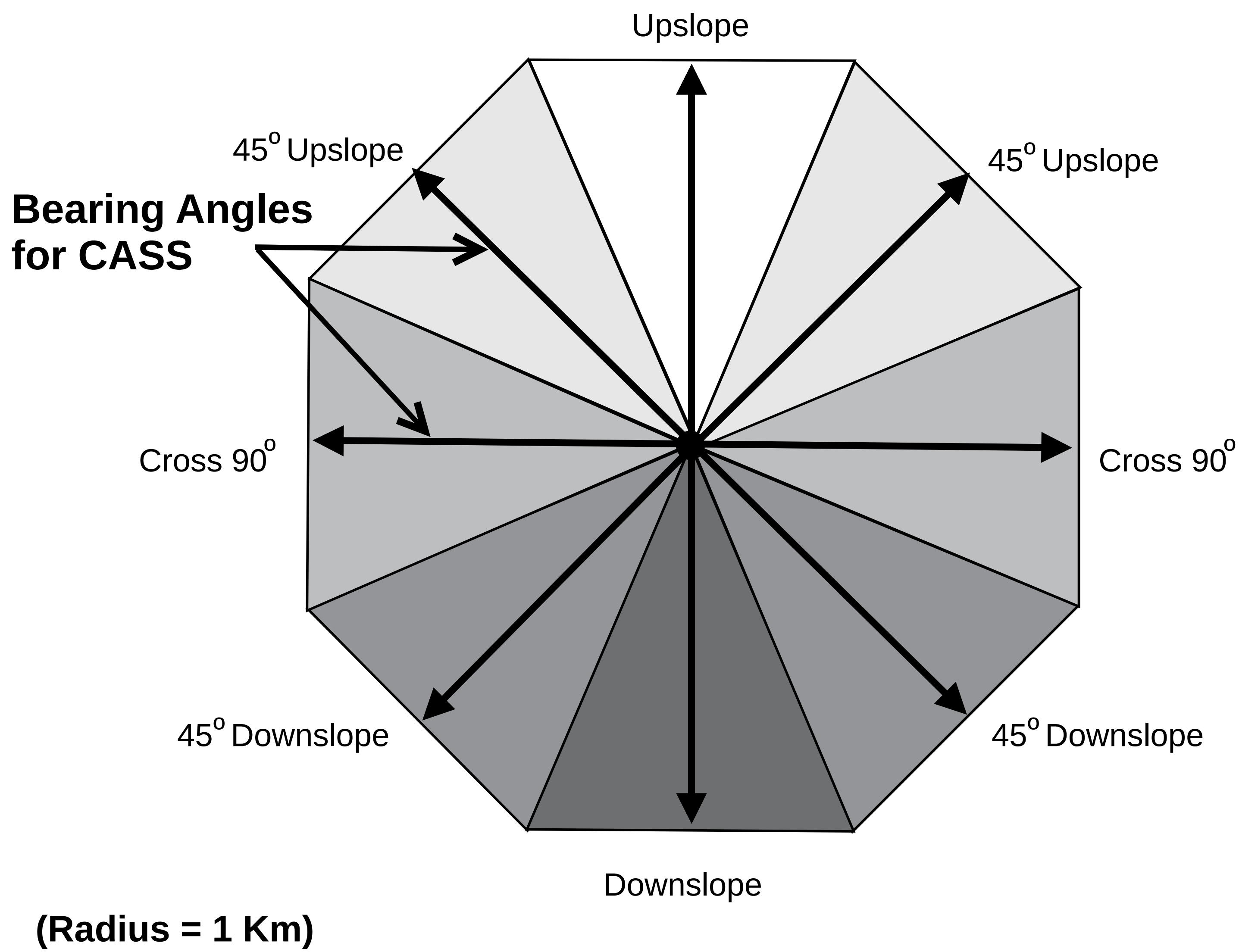

Figure 4.3-10

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.

Table 4.3-7

Example Calculation – Common Dolphin Level B Sound Exposure Estimate for SQS-53 Operation in Scenario 2 During Autumn at the Proposed Site D USWTR

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

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*.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, 2008o). 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

Species	**PTS**	**TTS**	**Non-TTS**
	ESA-Listed		
North Atlantic Right Whale	0	1	47
Humpback Whale	0	2	106
Fin Whale	0	0	0
Sperm Whale	0	0	0
	Non-ESA-Listed		
Minke Whale	0	0	7
Pygmy/dwarf Sperm Whales	0	3	163
Beaked Whales[1]	0	0	28
Rough-toothed Dolphin	0	1	77
Bottlenose Dolphin	4	747	49,757
Pantropical Spotted Dolphin	0	59	3,586
Atlantic Spotted Dolphin	3	808	46,558
Striped Dolphin	0	0	0
Clymene Dolphin	0	28	1,713
Common Dolphin	0	0	0
Risso's Dolphin	0	29	2,554
Pilot Whales	0	24	1,810

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

Species	PTS	TTS	Non-TTS
ESA-Listed			
North Atlantic Right Whale	0	0	4
Humpback Whale	0	0	23
Fin Whale	0	0	0
Sperm Whale	0	0	0
Non-ESA-Listed			
Minke Whales	0	0	1
Pygmy/dwarf Sperm Whales	0	1	29
Beaked Whales[1]	0	0	0
Rough-toothed Dolphin	0	0	12
Bottlenose Dolphin	0	76	3,298
Pantropical Spotted Dolphin	0	0	621
Atlantic Spotted Dolphin	0	0	2,405
Striped Dolphin	0	0	0
Clymene Dolphin	0	0	297
Common Dolphin	0	0	0
Risso's Dolphin	0	19	756
Pilot Whales	0	15	749

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 4.3-10

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

Species	PTS	TTS	Non-TTS
ESA-Listed			
North Atlantic Right Whale	0	0	3
Humpback Whale	0	0	0
Sei Whale[2]	-	-	-
Fin Whale	0	0	0
Sperm Whale	0	0	0
Non-ESA-Listed			
Minke Whale	0	0	8
Pygmy/dwarf Sperm Whale	0	3	162
Beaked Whales[1]	0	0	3
Rough-toothed Dolphin	0	1	77
Bottlenose Dolphin	1	240	21,861
Pantropical Spotted Dolphin	0	61	3,567
Atlantic Spotted Dolphin	1	304	14,050
Striped Dolphin	0	0	0
Clymene Dolphin	0	29	1,704
Common Dolphin	0	0	1
Risso's Dolphin	0	6	349
Pilot Whales	0	3	539
Harbor Porpoise[2]	-	-	-

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*.
[2] 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

Species	PTS	TTS	Non-TTS
ESA-Listed			
North Atlantic Right Whale	0	0	16
Humpback Whale	0	0	0
Sei Whale[2]	-	-	-
Fin Whale	0	2	85
Sperm Whale	0	1	268
Non-ESA-Listed			
Minke Whale	0	0	6
Pygmy/dwarf Sperm Whale	0	3	135
Beaked Whales[1]	0	0	128
Atlantic White-sided Dolphin[2]	-	-	-
Rough-toothed Dolphin	0	1	64
Bottlenose Dolphin	0	80	6,640
Pantropical Spotted Dolphin	0	66	2,975
Atlantic Spotted Dolphin	0	1	80
Striped Dolphin	1	159	12159
Clymene Dolphin	0	32	1,421
Common Dolphin	9	3,329	119,212
Risso's Dolphin	0	46	2,243
Pilot Whales	0	31	3,632
Harbor Porpoise[2]	-	-	-

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*.
[2] 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.

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 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, 2008l).

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 16 269sperm 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 resultling 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, 2008l). 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 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 Dolphin – 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 proposed Site D USWTR.

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

Helicopter Noise in Water: Total SPL (dB re 1 µPa)

Altitude	Source Level (at 1 m [3.3 ft] from helicopter)	Depth = 1 m (3.3 ft)	Depth = 122 m (400 ft)
15 m	150 dB	130 dB	101 dB
76 m	150 dB	119 dB	100 dB

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

$$SEL\ (dB\ re\ 1\ \mu\ Pa^2\text{-}s) \leq 130 + 10 \log T$$

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., 3x106 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 or 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 OPAREAs. 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 contructed 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 km^2 [100 NM^2]). 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.

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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 m^2 (5,000 ft^2) 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 m^2 (5,000 ft^2) 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 trunck 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 m^2 (5,000 ft^2) 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 m^2 (5,000 ft^2) 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 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

State	Relevant Enforceable Policy	Analysis	Conclusion
Florida	Beach and shore preservation	Cable burial is the only activity proposed for the area seaward of the mean high water line and within state coastal waters.	Not applicable
	Growth policy, county and municipal planning, land development regulation	Naval Station Mayport is federal property.	Not applicable
	State and regional planning	Naval Station Mayport is federal property.	Not applicable
	Emergency management	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.	Not applicable
	State lands	Naval Station Mayport is federal property.	Not applicable
	State parks and preserves	The proposed action would not affect any state parks or preserves.	Not applicable
	Land acquisition for conservation or recreation	No effect on land acquisition for conservation or recreation.	Not applicable
	Florida greenways and trails act	The proposed action would avoid the recreational trails system and would not affect the management of the system.	Not applicable
	Historical resources	No effect on historical resources.	Not applicable
	Commercial development and capital improvements	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.	Not applicable
	Transportation administration	The proposed action would not affect transportation.	Not applicable
	Transportation finance and planning	The proposed action would not affect transportation.	Not applicable
	Saltwater fisheries	No lethal or long-term impact to fish and no significant impact to fish habitats.	Consistent
	Wildlife	No significant effect on wildlife.	Consistent
	Water resources	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.	Consistent

Table 4.7-1(cont'd)
State Coastal Zone Enforceable Policies

	Outdoor recreation and conservation lands		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.	Not applicable
Florida (cont'd)	Pollutant discharge prevention and removal		The proposed action at the NAVSTA Mayport landfall site would not result in the production of hazardous waste or the discharge of pollution.	Not applicable
	Energy resources		The proposed action would not affect energy resources.	Not applicable
	Land and water management		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.	Not applicable
	Public health, general provisions		The proposed action does not involve the construction of an on-site sewage treatment and disposal system.	Not applicable
	Mosquito control		The proposed action would not affect mosquito control.	Not applicable
	Environmental control		Minimal, short-term impacts to water quality, and effects to ecological systems or air quality are not anticipated.	Consistent
	Soil and water conservation		Soil and erosion control measures would be implemented per Naval Station Mayport procedures.	Consistent
South Carolina	Tidelands and Coastal Waters	Cables, pipelines, and transmission lines	Directional drilling to install the landside portion of the trunk cable to avoid wetlands and other critical areas.	Consistent
		Dredging and filling	Use of ocean-bottom burial equipment to install the cable offshore of the landfall site.	Consistent
	Beaches and Dunes	Construction or repair of drives and parking lots	Action would not involve constructing or repairing drives or parking lots seaward of the setback line or seaward of the baseline.	Not applicable
		Installation or repair of underground and overhead lines	Action would not involve installing or repairing underground or overhead water, sewer, gas, electrical, telephone, or cable lines.	Not applicable

Table 4.7-1 (cont'd)
State Coastal Zone Enforceable Policies

State	Relevant Enforceable Policy	Analysis	Conclusion
South Carolina	Roads and highways	Action would not include construction of roads, highways, bridges, or transit facilities.	Not applicable
	Parking facilities	Action would not include siting or construction of parking facilities.	Not applicable
	Parks	Action would not include park development, construction of any park facilities, or the planning or design of parks and open space areas.	No applicable
	Wildlife and fisheries management	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.	Consistent
	Dredging	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.	Consistent
	Navigation channels	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.	Consistent
	Public open space	Underground installation would not result in the destruction of beach or dune vegetation. Action would not limit public access to the beach.	Consistent
	Stormwater runoff storage requirement	Navy would implement and maintain best management practices to minimize potential adverse impacts to water quality resulting from surface runoff.	Consistent
	Project size requiring stormwater management permits	Navy would implement and maintain best management practices to minimize potential adverse impacts to water quality resulting from surface runoff.	Consistent

Table 4.7.1 (cont'd)
State Coastal Zone Enforceable Policies

State	Relevant Enforceable Policy		Analysis	Conclusion
North Carolina	Shoreline erosion		Directional drilling with sedimentation control techniques, no changes to topography.	Consistent
	Shoreline access		Onslow Beach is not available for use by the general public.	Not applicable
	Mitigation		Jurisdictional wetlands would be avoided, no impacts anticipated.	Not applicable
	Coastal water quality		Temporary construction related turbidity, negligible metal contamination.	Consistent
	Coastal airspace		No change to existing airspace use.	Not applicable
	Areas of Environmental Concern	*Estuarine and Ocean Systems*	Erosion and sedimentation control would minimize construction related impacts to estuarine and ocean systems.	Consistent
		Ocean Hazard Areas	The installation of the trunk cable does not constitute a structure; the CTF is located outside of the hazard area.	Consistent
		Natural and Cultural Resource Areas	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.	Consistent
Virginia	Fisheries management		No change to fisheries management program or initiatives. Any impacts to fish and their habitats would be insignificant.	Consistent
	Subaqueous lands management		Cable burial would cause minimal, short-term impacts to water quality due to temporary disturbance of bottom sediments.	Consistent
	Wetlands management		Directional drilling to avoid wetlands to the maximum extent practicable. If unavoidable, appropriate permits would be obtained prior to construction.	Consistent
	Dunes management		Primary sand dunes would not be altered or destroyed.	Consistent
	Non-point source pollution control		Sediment control measures would be utilized to minimize potential adverse impacts to water quality.	Consistent
	Coastal lands management		Proposed action does not involve any activities in a designated Chesapeake Bay Preservation Area.	Not Applicable

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

(Scowcroft et al., 2006). 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 in^3). 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 mammas 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.

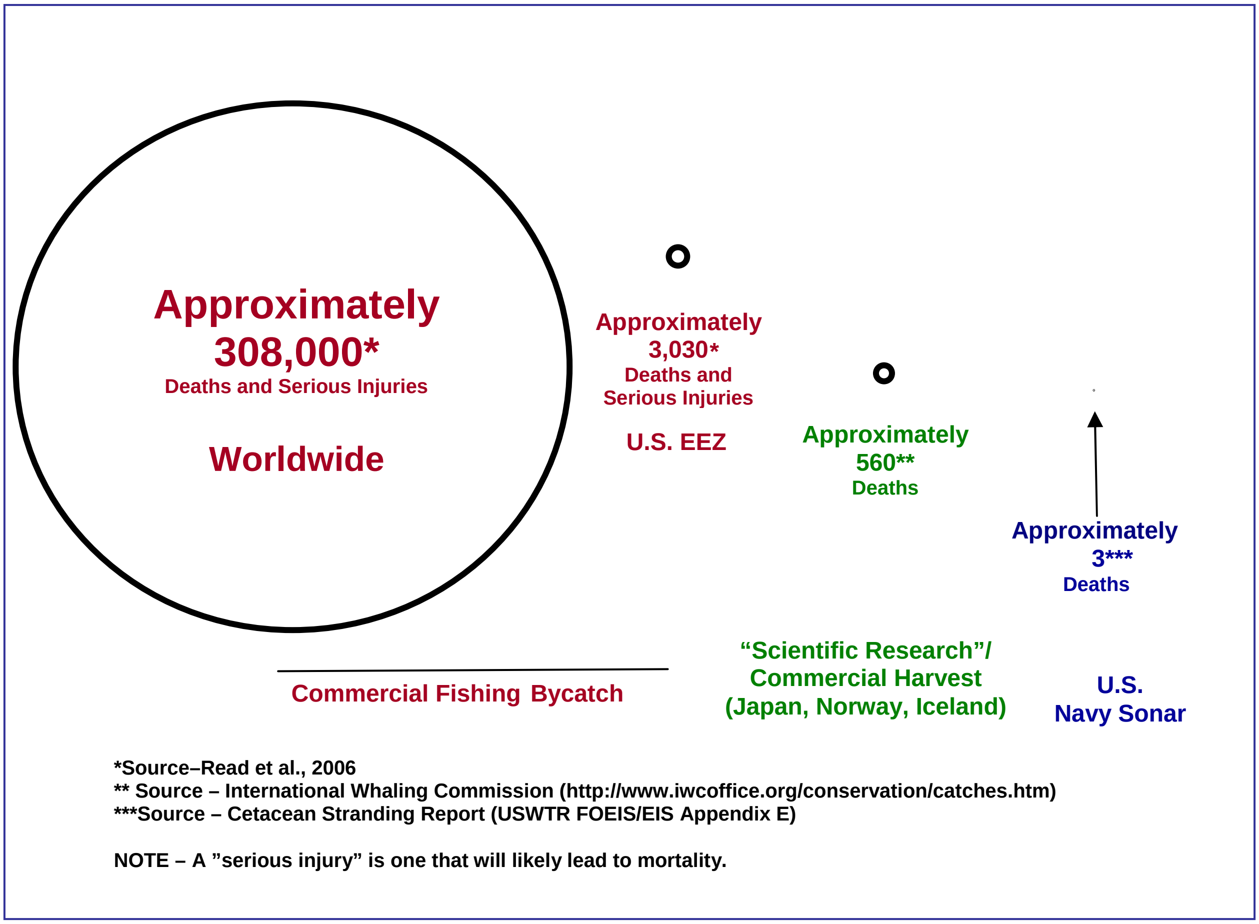

Figure 4.8-1

Annual Comparison of Cetacean Death by Activity

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

Fishery Description	Estimated Number of Vessels/Persons	Marine Mammal Species Incidentally Killed/Injured		
Gillnet Fisheries	>1,011	Fin whale Humpback whale Long-finned pilot whale Minke whale Atlantic Ocean right whale Short-finned pilot whale	Bottlenose dolphin Common dolphin Harbor porpoise Risso's dolphin White-sided dolphin	Gray seal Harbor seal Harp seal Hooded seal
Longline Fisheries	94*	Cuvier's beaked whale Long-finned pilot whale Mesoplodon beaked whale Northern bottlenose whale Pygmy sperm whale Short-finned pilot whale	Atlantic spotted dolphin Bottlenose dolphin Common dolphin Pantropical spotted dolphin Risso's dolphin	----
Trap/Pot Fisheries	13,000	Fin whale Humpback whale Minke whale Atlantic Ocean right whale	----	Harbor seal

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 km^2 (144,375 mi^2) from Maine to New Jersey (MMS, 2007a). In 1979, 63 blocks (1,452 km^2 or 560 mi^2) 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 km^2 (276,438 mi^2) from Delaware to the southern most tip of Florida. From 1959 until 2000, 307 blocks (8,531 km^2 or 3,294 mi^2) 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.

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 km^2 (27,661 NM^2). 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)

Range Operation	Description
Mine Warfare (MIW)	
Mine countermeasures exercise	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.
Mine neutralization	These operations involve the detection, identification, evaluation, rendering safe, and disposal of underwater unexploded ordnance (UXO) that constitute a threat to ships or personnel.
Surface Warfare (SUW)	
Bombing exercise (BOMBEX) (sea)	These exercises allow aircrew to train in the delivery of bombs against maritime targets.
Missile exercise (MISSILEX) (air-to-surface)	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.
Gunnery exercise (GUNEX) (air-to-surface)	Gunnery exercises train fixed-wing aircraft and helicopter aircrews to attack surface targets at sea using guns.
GUNEX (surface-to-surface) (boat)	In these exercises, small boat gun crews train by firing against surface targets at sea.
GUNEX (surface-to-surface) (ship)	Ship gun crews in these exercises train by firing against surface targets at sea.
Laser targeting	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.
Visit, Board, Search, and Seizure/Maritime Interdiction Operations (VBSS/MIO)-Ship	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.

Table 4.8-2 (cont'd)

VACAPES Range Complex Typical Operations (Non-ASW)

Air Warfare (AW)	
Air combat maneuver (ACM)	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.
GUNEX (air-to-air)	In these training operations, guns are fired from aircraft against unmanned aerial target drones.
MISSILEX (air-to-air)	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.
GUNEX (surface-to-air)	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.
MISSILEX (surface-to-air)	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.
Air intercept control	Surface ship and fixed-wing aircraft crew train in using their search radar capability to direct strike fighter aircraft toward threat aircraft.
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 point of engagement, with the goal of destroying the threat before it can damage the ship.
Strike Warfare (STW)	
High-Speed Anti-Radiation Missile Exercise (HARMEX) (air-to-surface)	Aircrews train in the use of High-Speed Anti-Radiation Missiles (HARM), the primary weapon designed to target anti-aircraft missile sites.
Amphibious Warfare (AMW)	
Firing exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	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.
Electronic Combat (EC)	
Chaff exercise	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.
Flare exercises	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.
Electronic combat operations	Ship-borne electronic combat operations or command and control warfare attempts to control critical portions of the electromagnetic spectrum.
Test and Evaluations	
Shipboard Electronic Systems Evaluation Facility (SESEF) utilization	SESEF operations test ship antenna radiation pattern measurements and communication systems.

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)

Range Operation	Description
Mine Warfare (MIW)	
Mine countermeasures (MCM)	Helicopters, surface and subsurface units detect, identify, classify, mark, disable and/or destroy sea mines using a variety of methods.
Mine neutralization	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.
Surface Warfare (SUW)	
Bombing Exercise (Sea) (BOMBEX A-S)	Fixed wing aircraft deliver bombs against maritime targets.
Missile Exercise (Air-to-Surface)	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.
Gunnery Exercise (Air-to-Surface)	Air-to-Surface Gunnery Exercise (GUNEX) trains fixed-wing aircraft and helicopter aircrews to attack surface targets at sea using guns.
Gunnery Exercise Ship (Surface-to-Surface) (GUNEX S-S (Ship))	Surface ships fire main battery guns and crew-served weapons against maritime targets.
Visit, Board, Search, and Seizure/Maritime Interdiction Operations (VBSS/MIO)-Ship and Helo	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.
Air Warfare (AW)	
Air Combat Maneuver (ACM)	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.
GUNEX (Air-to-Air)	GUNEX Air-to-Air training operations in which guns are fired from aircraft against unmanned aerial target drones.
MISSILEX (Air-to-Air)	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.
Air Intercept Control (AIC)	Surface ships vector friendly aircraft to intercept and destroy adversary aircraft.

Table 4.8-3 (cont'd)

Cherry Point Range Complex Typical Operations (Non-ASW)

Electronic Combat (EC)	
Electronic Combat Operations (EC)	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 attach and/or recognize an emerging threat early enough to take the necessary defensive actions.
Chaff Exercise	Ships and aircraft deploy chaff to disrupt threat targeting and missile guidance radars and to defend against an attack.
Flare Exercise	Aircraft deploy flares to disrupt threat infrared guidance systems of threat missiles.
Strike Warfare (STW)	
High-Speed Anti-Radiation Missile Exercise (HARMEX) (air-to-surface)	Aircraft crews train in the use of High-Speed Anti-Radiation Missiles (HARM), the primary weapon designed to target anti-aircraft missile sites.
Amphibious Warfare (AMW)	
Firing Exercise (FIREX)-Land (FIREX (Land))	Surface ships fire main battery guns against land targets in support of military operations ashore.
Integrated Maritime Portable Acoustic Scoring and Simulator System (IMPASS)	This training is conducted at-sea using a computer simulated land target and a series of buoys that can acoustically score the training event.
Amphibious Assault	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.
Firing Exercise (FIREX)-Land (FIREX (Land))	Surface ships fire main battery guns against land targets in support of military operations ashore.
Amphibious Raid	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.

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 km^2 (18,617 NM^2). 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.navycherrypointrangecomplexeis.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 m^2 (6,266 ft^2) of disturbance to benthic habitats per year, of which only a percentage of the total benthic area affected, less than 582 m^2 (6,266 ft^2) 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 km^2 (865 NM^2) 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 5.35×10^{-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.navycherrypointrangecomplexeis.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 alterative. 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 km^2 (45 mi^2). 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 km^2 (246 mi^2) 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. Atlernative 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 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 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 km^2 (50,090 NM^2). 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 km^2 (25 mi^2). 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 km^2 (5 mi^2) 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.jacksonvillerangecomplexeis.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

JAX Range Complex Typical Operations (Non-ASW)

Range Operation	Description
Mine Warfare (MIW)	
Mine Laying	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.
Mine countermeasures	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.
Mine neutralization	Mine Neutralization operations involve the detection, identification, evaluation, rendering safe, and disposal of underwater unexploded ordnance that constitute a threat to ships or personnel.
Surface Warfare (SUW)	
MISSILEX (A-S)	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.
GUNEX (A-S)	GUNEX (A-S) trains aircraft and helicopter crews to attack surface targets at sea using guns.
GUNEX (S-S)	GUNEX (S-S) trains ship gun crews by firing against surface targets at sea.
BOMBEX (sea)	BOMBEX (sea) allows aircrew to train in the delivery of bombs against maritime targets.
Laser targeting	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.
Visit, Board, Search, and Seizure/Maritime Interdiction Operations (VBSS/MIO)-Ship	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.
VBSS/MIO-Helicopter	Non-firing ULT & major exercise events. NSW personnel fast-rope onto target vessel from 1st helicopter. 2nd helicopter flies close cover, and 3rd helicopter flies surveillance.
GUNEX (S-S) (Fast Attack Craft/Fast Inshore Attack Craft [FAC/FIAC])	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.
Air Warfare (AW)	
ACM	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.
Air Intercept Control	Surface ships and fixed wing aircraft train in using their search radar capability to direct strike fighter aircraft toward threat aircraft.
ACM Chaff Exercise	Chaff exercises train shipboard personnel and helicopter crews in the use of chaff to counter missile threats. Training and testing evens not necessarily dedicated events, but combined with other exercises.

Table 4.8-4 (cont'd)

JAX Range Complex Typical Operations (Non-ASW)

Air Warfare (AW) Cont'd	
ACM Flare Exercise	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.
MISSILEX (A-A)	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.
GUNEX (Air-to-Air)	GUNEX Air-to-Air training operations in which guns are fired from aircraft against towed aerial target banner.
GUNEX (S-A)	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.
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)	
FIREX with Integrated Maritime Portable Acoustic Scouring and Simulator System (IMPASS)	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.
BOMBEX (A-G)	BOMBEXs (Land) allow aircrews to train in the delivery of bombs against ground targets at Rodman Range.
Combat Search and Rescue (CSAR) and Convoy Operations	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.
Electronic Combat (EC)	
EC Operations	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.
Chaff Exercise	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.
Flare Exercise (Aircraft Self-Defense)	Fixed-wing aircraft and helicopters deploy flares to disrupt threat infrared missile guidance systems to defend against an attack.
Other Training	
Shipboard Electronic Systems Evaluation Facility Utilization (SESEF)	SESEF operations test ship antenna radiation pattern measurements and communications systems.
Other Training	
Small Arms Training with anti-swimmer grenades	Training with anti-swimmer grenades (MK3A2, 8 oz HE). Not all events use explosive rounds in the exercise.

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 m^2 [9,482 ft^2] per year), and only a percentage (less than 881 m^2 [9,482 ft^2] 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 km^2 (18,919 NM^2) 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 x 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.

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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.

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.

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 Porstmouth, 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 CISMMA 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 (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). 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:

- 26º 05’ 53.18”N 79º 55’ 55.37”W
- 26º 04’ 08.56”N 79º 55’ 56.32”W
- 26º 05’ 51.41”N 79º 52’ 03.65”W
- 26º 04’ 06.8”N 79º 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 km^2 (6 NM^2); 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 km^2 (24 mi^2) (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 km^2 (8 mi^2) (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 km^2) (0.3 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.

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:

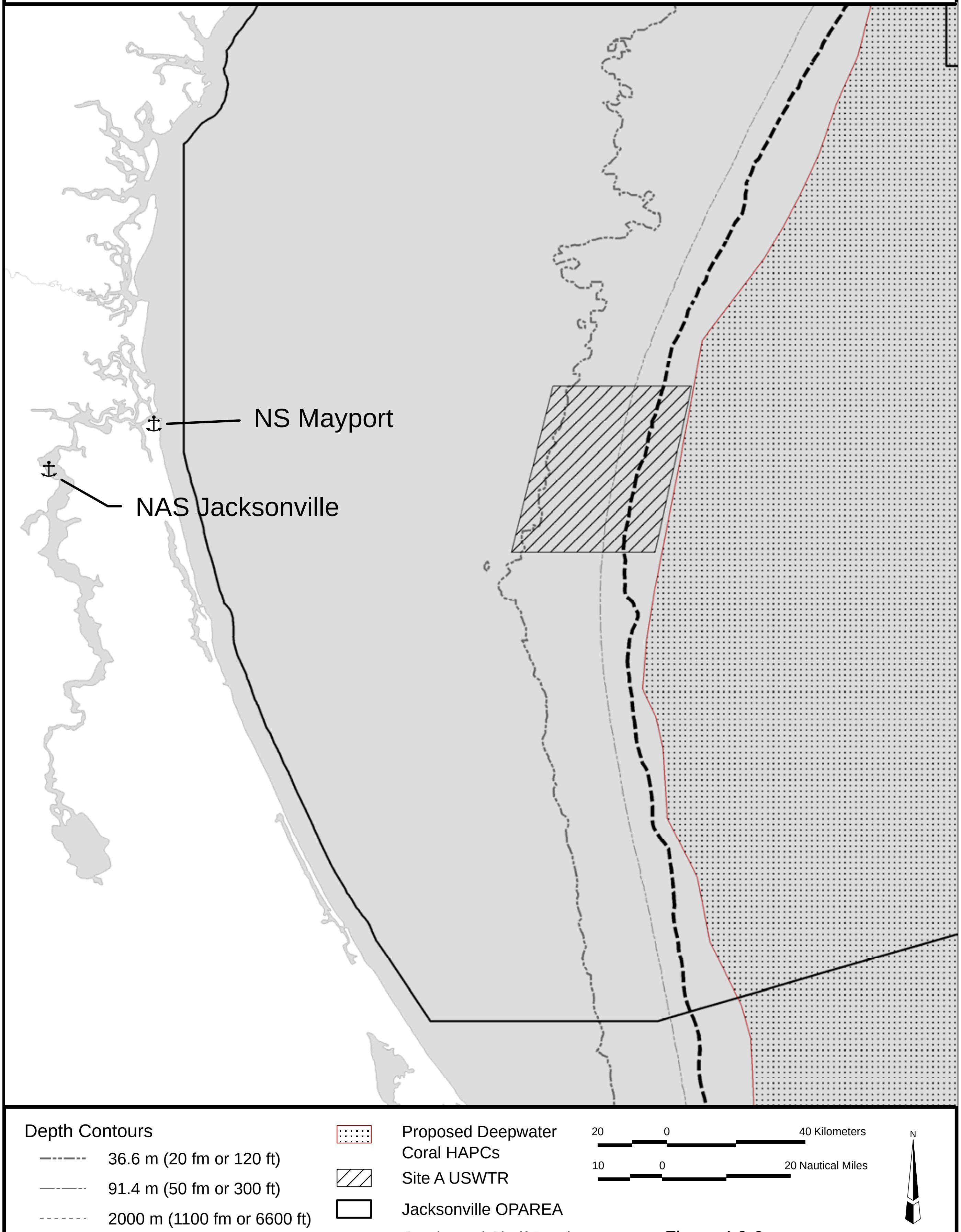
- A "NE" value would be given to an action that has no adverse effects to a particular resource.
- A "*" would be given to an action that has the potential for minor, but recoverable, adverse effects to a particular resource. Examples include a negligible or less than significant effect to a resource.
- 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.

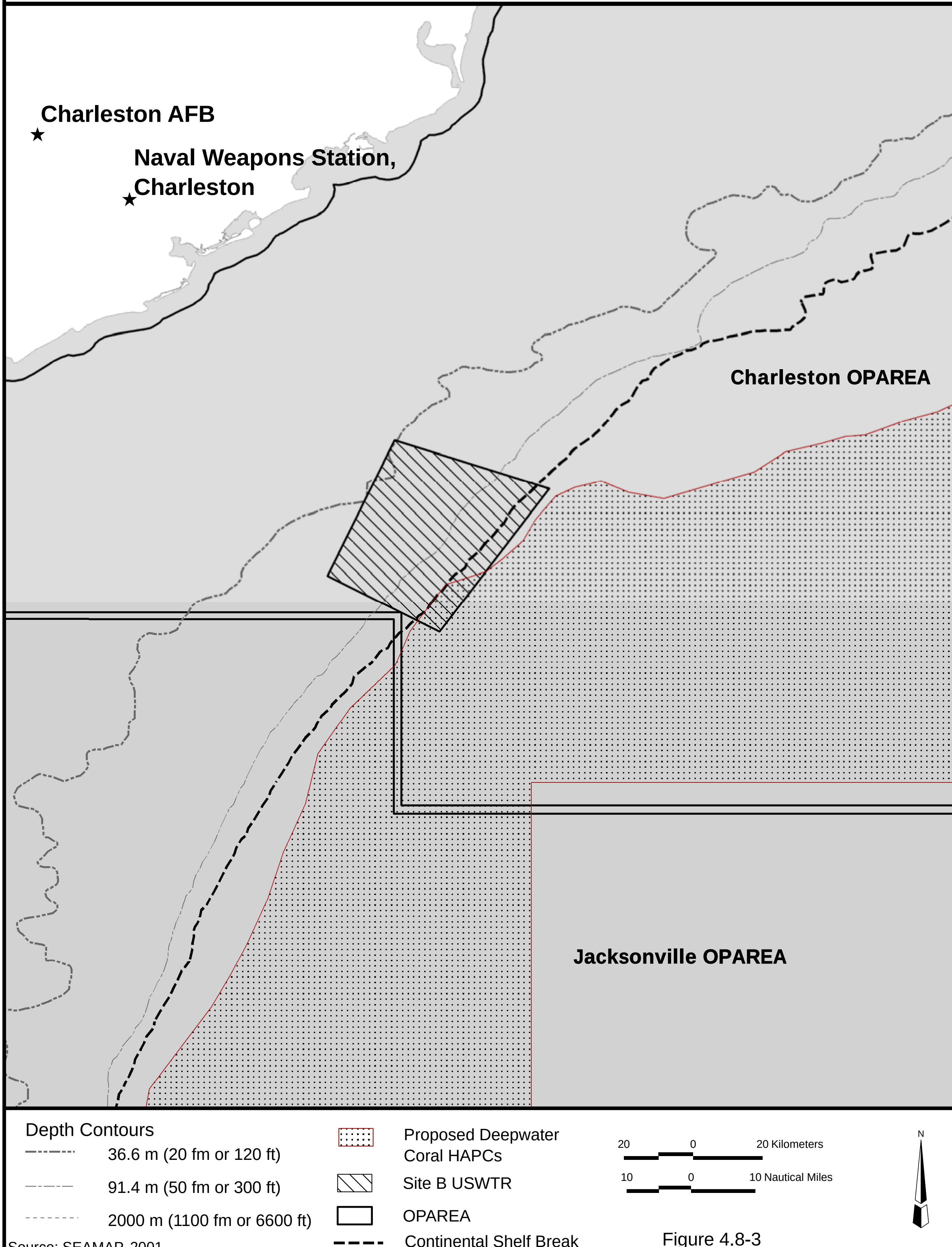
Proposed Deepwater Coral HAPCs - Site A



Source: SEAMAP, 2001.

Figure 4.8-2

Proposed Deepwater Coral HAPCs - Site B



Source: SEAMAP, 2001.

Figure 4.8-3

Table 4.8-5

Summary of Cumulative Impacts in the Study Area

		Sediment Quality	Marine Debris (Marine Habitat)	Water Quality	Sound in the Environment	Marine Mammals	Sea Turtles	Marine Fish	Essential Fish Habitat	Sea Birds	Marine Invertebrates	Marine Plants and Algae	National Marine Sanctuaries	Airspace Management	Energy Exploration and Offshore Drilling	Recreational Boating	Commercial and Recreational Fishing	Commercial Shipping	Cultural Resources
Past and Present Actions	Military Operations	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	MMS: Oil and Gas	**	*	**	*	**	**	*	*	**	*	*	*	NE	NA	NE	NE	NE	*
	State Oil and Gas	**	*	**	*	**	**	*	*	**	*	*	*	NE	NA	NE	NE	NE	*
	Dredging	**	**	**	*	NE	**	**	**	NE	**	**	**	NE	NE	NE	NE	NE	*
	Commercial and Recreational Fishing	*	**	NE	*	**	**	**	**	**	**	NE	**	NE	NE	NE	NA	NE	*
	Maritime Traffic	*	*	*	*	**	*	NE	NE	NE	NE	NE	*	NE	NE	NA	NE	NA	*
	Scientific Research	NE	*	NE	NE	*	*	*	*	*	*	*	*	NE	**	NE	**	NE	NE
	Debris	NA	NA	*	NE	**	**	**	**	**	**	NE	*	NE	NE	*	*	*	*
	Environmental Contamination and Biotoxins	NA	NA	**	NE	**	**	**	**	**	**	**	**	NE	NE	NE	**	NE	NE
	Marine Ecotourism	NE	*	*	*	*	*	NE	NE	NE	NE	NE	*	NE	NE	NA	NE	NE	NE
Future Actions	Military Operations	*	*	*	*	*	*	*	*	*	*	*	*	*	NE	*	*	*	*
	NASA	NE	*	NE	*	NE	NE	NE	NE	*	NE	NE	NE	*	NE	NE	NE	NE	NE
	Offshore LNG	*	**	*	*	*	*	*	*	*	*	*	*	NE	NE	NE	NE	NE	*
	Offshore Windfarms	*	*	**	*	*	*	*	*	**	*	*	*	NE	NE	NE	NE	NE	*
	AFAST	*	*	*	*	**	**	*	*	NE	NE	NE	NE	NE	*	NE	*	*	*
USWTR Proposed Action		*	*	*	*	**	**	*	*	NE	*	NE	NE	NE	*	NE	*	*	*
Cumulative Impacts of All Actions		*	*	*	*	**	**	*	*	*	*	*	*	NE	*	*	*	*	*

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

Material	Invertebrates	Fish	Reptiles	Birds	Mammals	Amphibians	Total	
Balloon ribbon/string	0	0	0	4	1	0	5	**2.1%**
Beverage Can	1	1	0	0	0	0	2	**0.9%**
Building Materials	2	0	0	0	2	0	4	**1.7%**
Crab/Lobster/Fish Traps	2	1	0	0	0	0	3	**1.3%**
Fishing Line	22	32	5	43	8	0	110	**46.8%**
Fishing Nets	13	12	0	6	4	0	35	**14.9%**
Glass Bottles	3	2	1	0	2	0	8	**3.4%**
Miscellaneous	2	0	2	5	1	0	10	**4.3%**
Plastic Bags	2	3	0	12	5	0	22	**9.4%**
Plastic Container	0	0	0	0	1	0	1	**0.4%**
Rope	1	9	2	6	5	1	24	**10.2%**
Six-pack Holders	0	2	0	1	0	0	3	**1.3%**
Tire	0	1	1	0	0	0	2	**0.9%**
Wire	1	0	0	4	1	0	6	**2.6%**
Totals	**49**	**63**	**11**	**81**	**30**	**1**	**235**	**100.0%**
Total Percentage	**20.9%**	**26.8%**	**4.7%**	**34.5%**	**12.8%**	**0.4%**	**100.0%**	

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 (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 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 trawlers, 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

Effect	Criteria	Metric	Threshold
Mortality	Onset extensive lung injury	Goertner modified positive impulse (function of depth and animal weight)	30.5 psi-ms
Physiological	Onset slight lung injury/PTS	Goertner modified positive impulse	indexed to 13 psi-ms
Behavioral	TTS (Temporary Threshold Shift)	Greatest energy flux density level in any 1/3-octave band above 100 Hz - for total energy over all exposures	182 dB re 1 μPa2-s
Behavioral	TTS	Peak pressure over all exposures	23 psi
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

Species	Mortality			PTS			TTS		
	JAX/ CHASN	CHPT	VACAP ES	JAX/ CHASN	CHPT	VACAP ES	JAX/ CHASN	CHPT	VACAP ES
Loggerhead sea turtle	0	0	0	0*	0*	0*	1	0*	1
Kemp's ridley sea turtle[1]	0	0	0	0	0	0	0	0	0
Leatherback sea turtle	0	0	0	0	0	0	0	0	0*
Hardshell sea turtles[2]	0	0	0	0*	0	0*	0*	0	0*

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 CO_2 dissolved in ocean water that creates carbonic acid. The CO_2 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 marine mammals. Since the USWTR activities will not take place in Arctic waters, additional discussion on subsistence use is not warranted.

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

Environmental Resources		Site A	Site B	Site C	Site D
Non-Acoustic Environmental Impacts	Geology, Bathymetry and Substrate, and Water Quality	There would be no significant impact or significant harm.	There would be no significant impact or significant harm.	There would be no significant impact or significant harm.	There would be no significant impact or significant harm.
	Plankton and Benthos	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.	There would be no significant impact or significant harm. The placement of cables and transducer nodes may potentially result in minor localized damage to the live deep-water corals.
	Fish	There would be no significant impact or significant harm to fish.	There would be no significant impact or significant harm to fish.	There would be no significant impact or significant harm to fish.	There would be no significant impact or significant harm to fish.
	Essential Fish Habitat	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH.	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH. Potential significant impact to biogenic reef EFH if *Lophelia* Reefs are impacted. The Navy would consult with NMFS to avoid / reduce impacts.	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH. Potential significant impact to biogenic reef EFH if *Lophelia* Reefs are impacted. The Navy would consult with NMFS to avoid / reduce impacts.	Potential minor adverse impacts to benthic substrate EFH, hard bottom substrate EFH, biogenic reef substrate EFH, and nearshore EFH.

Table 4.9-1

Summary of Environmental Impacts

Environmental Resources		Site A	Site B	Site C	Site D
Non-Acoustic Environmental Impacts Cont'd	Sea Turtles and Marine Mammals	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.	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.	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.	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.
	Seabirds and Migratory Birds	No significant impact to seabirds or migratory birds would occur.	No significant impact to seabirds or migratory birds would occur.	No significant impact to seabirds or migratory birds would occur.	No significant impact to seabirds or migratory birds would occur.
	Endangered and Threatened Species	<u>Species</u> There may be an effect to ESA-listed species. The Navy is consulting with the NMFS to avoid / reduce impacts. <u>Critical Habitat</u> To avoid / reduce potential impacts on North Atlantic right whale critical habitat, the Navy would consult with the NMFS and comply with ESA.	<u>Species</u> There may be an effect to ESA-listed species. The Navy would consult with the NMFS to avoid / reduce impacts. <u>Critical Habitat</u> No designated critical habitats occur within the range.	<u>Species</u> There may be an effect to ESA-listed species. The Navy would consult with the NMFS to avoid / reduce impacts. <u>Critical Habitat</u> No designated critical habitats occur within the range.	<u>Species</u> There may be an effect to ESA-listed species. The Navy would consult with the NMFS to avoid / reduce impacts. <u>Critical Habitat</u> No designated critical habitats occur within the range.

Table 4.9-1

Summary of Environmental Impacts

Environmental Resources		Site A	Site B	Site C	Site D
Acoustic Environmental Impacts	Marine Mammals	ESA-listed Species Level B harassment of two species (North Atlantic right whale and humpback whale). Non-ESA listed Species Level B harassment of ten species. 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.	ESA-listed Species Level B harassment of two species (North Atlantic right whale and humpback whale). Non-ESA listed Species Level B harassment of nine species. 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.	ESA-listed Species Level B harassment of one ESA-listed species (North Atlantic right whale). Non-ESA listed Species Level B harassment of eleven species. 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.	ESA-listed Species Level B harassment of three species (North Atlantic right whale, fin whale, and sperm whale). Non-ESA listed Species Level B harassment of twelve species. 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.
	Fish	There would be no significant impact to fish populations.	There would be no significant impact to fish populations.	There would be no significant impact to fish populations.	There would be no significant impact to fish populations.
	Scuba Diving	Following Navy operating procedures, no impacts to divers would occur.	Following Navy operating procedures, no impacts to divers would occur.	Following Navy operating procedures, no impacts to divers would occur.	Following Navy operating procedures, no impacts to divers would occur.
Socioeconomics		There would be no significant impact.	There would be no significant impact.	There would be no significant impact.	There would be no significant impact.
Cultural Resources		There would be no significant impact.	There would be no significant impact.	There would be no significant impact.	There would be no significant impact.
Landside Resources		There would be no significant impact. Prior to installation	There would be no significant impact. Prior to installation	There would be no significant impact. Prior to installation	There would be no significant impact. Prior to installation

Table 4.9-1

Summary of Environmental Impacts

Environmental Resources	Site A	Site B	Site C	Site D
	of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/ mitigation measures.	of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/ mitigation measures.	of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/ mitigation measures.	of the range, the Navy would coordinate with the appropriate resource agency(ies) and implement appropriate avoidance/ mitigation measures.
Coastal Zone Management	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the Florida coastal zone management program.	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the South Carolina coastal zone management program.	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the North Carolina coastal zone management program.	The proposed action is consistent to the maximum extent practicable with the enforceable policies of the Virginia coastal zone management program.

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5 UNAVOIDABLE ADVERSE IMPACTS AND COMMITMENTS OF RESOURCES

5.1 Unavoidable Adverse Impacts

Unavoidable adverse impacts at sea would include temporary disturbance to the sea floor due to the trenching and cable laying operations associated with the construction of the proposed USWTR. The trunk cable connecting the range to the shore facilities would be buried and the interconnect cable between each node would be buried if deemed necessary at individual locations within a range. Range instrumentation and interconnect cable sections that are not buried would be colonized by bottom-dwelling organisms.

During ASW training on the proposed USWTR, temporary behavioral disturbance to marine mammals within close proximity to mid-frequency active sonar systems could occur. The Navy would follow mitigation measures and conservation measures outlined in Chapter 6 of this final OEIS/EIS to minimize potential acoustic effects to marine mammals.

A number of hardware items such as MK39 EMATTs, aluminum canisters, protective nose covers, air stabilizers, steel wires, and steel-jacketed lead ballast would sink to the bottom after use and be left on the range. Over time, these items would be expected to deteriorate, be covered by shifting sediments, or be colonized by organisms seeking hard substrate. Unavoidable adverse ecological impacts due to Navy training on the proposed USWTR would be minor, temporary, and not significant.

Unavoidable adverse impacts to the landside portion at the alternate USWTR locations may include minor impacts to wetlands during installation of the trunk cable. Every effort would be made to avoid wetlands through cable alignment, trenching, and directional drilling. The Navy will work with the USACE to avoid, minimize, or mitigate any potential minor wetland impacts that might be incurred during cable and CTF installation. There could be temporary impacts to federally threatened or endangered species during installation of the trunk cable; however, consultation with the USFWS would be conducted before initiating any construction activities.

5.2 Relationship Between Local Short-Term Uses of Man’s Environment and the Maintenance and Enhancement of Long-Term Productivity

The purpose of the proposed construction and operation of the USWTR is to enable the Navy to train effectively in a shallow water coastal environment at a suitable location for the Atlantic Fleet. The Navy's primary mission is to maintain, train, equip, and operate combat-ready naval forces capable of resolving conflicts, deterring aggression, and maintaining freedom of the seas. ASW is a critical part of that mission. The Navy currently lacks an instrumented shallow-water undersea warfare training range on the east coast that could replicate the environment of strategic areas, a tool that is necessary to provide real-time training and feedback on training effectiveness. Building an instrumented shallow-water undersea warfare training range offshore of the east coast of the U.S. would allow the Navy to optimize the training of our Sailors to counter the growing, clear, and present threat posed by submarines to our armed forces, the Sailors and Marines defending our homeland, logistic shipping, and United States citizens both at home and overseas.

Both short- and long-term commitments of labor and capital, along with use of non-renewable materials for power and maintenance, would result from the construction and operation of the proposed USWTR. Adherence to the proposed mitigation measures (Chapter 6) would minimize the effects of the proposed USWTR operations on both the marine and *landside* environments. Further, long-term monitoring would improve knowledge of the marine environment in the proposed range area at sea. Consequently, the majority of the effects of constructing and operating the proposed USWTR would be temporary in nature (as described in Chapter 4) and would have no significant adverse long-term impacts on the maintenance and enhancement of long-term productivity.

5.3 Irretrievable and Irreversible Commitments of Resources

Irretrievably and irreversibly committed resources are those that are consumed during the construction and implementation of a project and that cannot be reused. Because their reuse is impossible, they are considered irretrievably and irreversibly committed to the development of the proposed project. These resources would include expendable materials necessary for construction, as well as fuels and other forms of energy that are utilized during project implementation.

During construction and operation of the USWTR, non-renewable resources would be consumed. Since the reuse of these resources may not be possible, they could be considered irreversibly and irretrievably committed should the proposed construction and operation of USWTR be implemented. The non-renewable resources would include materials such as steel, concrete, and fuel used during construction of the USWTR, as well as supplies and energy resources necessary for the training exercises. Devices expended on the range during training exercise (e.g., BTs, sonobuoys, torpedo control wires, and steel-jacketed lead ballast weights) would also be considered non-renewable resources.

6 MITIGATION MEASURES

Effective training dictates that ship, submarine, and aircraft participants utilize their sensors to their optimum capabilities as required by mission. The Department of the Navy (DoN) recognizes that such use has the potential to cause behavioral disruption of some marine mammal species in the vicinity of training, as discussed in Chapter 4.

Mitigation measures to protect marine mammals and sea turtles listed under the Endangered Species Act (ESA) during Navy training on the proposed USWTR are addressed in this chapter. This chapter is comprised of six subchapters containing:

- a detailed description of mitigation with respect to acoustical effects on marine animals (6.1).
- a discussion of the mitigation related to vessel transits in the vicinity of mid-Atlantic ports during North Atlantic right whale migratory seasons and in the vicinity of NMFS-designated critical habitat off the southeastern U.S. (6.2).
- a description of the mitigation related to the landside component of the proposed USWTR project (6.3).
- a description of the mitigation measures that would be employed during cable installation (6.4).
- a statement of dedication to dynamic mitigation as conditions change with time (6.5).
- a discussion of the other mitigation measures that have been considered and rejected (6.6).

It should be noted that several of these mitigation measures presented continue the development of mitigation measures for unit-level training that the Navy has had in place since 2004. In addition, the Navy coordinated with the National Marine Fisheries Service (NMFS) to further develop measures for protection of marine mammals during other active sonar consultations. Those mitigations for mid-frequency active sonar are detailed below. This chapter also presents a discussion of other measures that have been considered and rejected because they either:

- are not feasible
- present a safety concern
- provide no known or ambiguous protective benefit, or

- impact the effectiveness of the required military readiness activity.

In order to make the findings necessary to issue the Marine Mammal Protection Act (MMPA) authorization, it may be necessary for NMFS to require additional mitigation or monitoring measures beyond those addressed in this final OEIS/EIS. These could include measures considered, but eliminated, in this final OEIS/EIS, or measures yet to be developed. In addition to commenting on this final OEIS/EIS, the public will have an opportunity to provide information to NMFS through the MMPA process, both during the comment period following NMFS' Notice of Receipt of the application for a Letter of Authorization (LOA), and during the comment period following NMFS' publication of the proposed rule. NMFS may propose additional mitigation or monitoring measures in the proposed rule.

For the purposes of the ESA Section 7 consultation, the mitigation measures proposed here may be considered by NMFS as beneficial actions taken by the Federal agency or applicant (50 CFR 402.14[g][8]). If required to satisfy requirements of the Endangered Species Act, NMFS may develop an additional set of measures contained in Reasonable and Prudent Alternatives, Reasonable and Prudent Measures, or Conservation Recommendations in any Biological Opinion issued for this Proposed Action.

6.1 Protective Measures Related to Acoustic Effects

Effective training on the proposed USWTR dictates that ship, submarine, and aircraft participants utilize their sensors and exercise weapons to their optimum capabilities. Recognizing that such use may adversely affect some ESA-listed marine mammals on the range, the Navy has developed protective measures related to acoustic effects.

The typical ranges, or distances, from the most powerful and common active sonar sources to be used in USWTR to received sound energy levels associated with TTS and PTS are shown in Table 6-1. Due to spreading loss, sound attenuates logarithmically from the source, so the area in which an animal could be exposed to potential injury (PTS) is small. Because the most powerful sources would typically be used in relatively deep water and the range to effect is limited, spherical spreading is assumed for 195 decibels referenced to 1 micro-Pascal squared second (dB re 1µPa^2-s) and above. Also, due to the limited ranges, interactions with the bottom or surface ducts are rarely an issue.

Table 6-1

Range to Effects for Active Sonar

Sonar Source	215 dB re 1 μPa^2-s received EL (PTS)	195 dB re 1 μPa^2-s received EL (TTS)
AN/SQS-53	10 m	100-300 m
AN/SQS-56 or AN/AQS-22	5 m	30-60 m
DICASS sonobuoy	never in a realistic operating environment	3-6 m

6.1.1 Personnel Training

Navy shipboard lookouts are highly qualified and experienced marine observers. At all times, the shipboard lookouts are required to sight and report all objects found in the water to the Officer of the Deck (OOD). Objects (e.g., trash, periscope) or disturbances (e.g., surface disturbance, discoloration) in the water may indicate a threat to the vessel and its crew. Navy lookouts undergo extensive training 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 (PQS) program, certifying that they have demonstrated the necessary skills to detect and report partially submerged objects. In addition to these requirements, many lookouts periodically undergo a two-day refresher training course.

Marine mammal mitigation training for those who would use the proposed USWTR is a key element of the mitigation measures. The goal of this training is twofold:

- That USWTR personnel operating the active sonar understand the details of the mitigation measures and be competent to carry out these measures.
- That key personnel onboard Navy platforms exercising in the proposed USWTR understand the mitigation measures and be competent to carry them out.

For the past few years, the Navy has implemented marine mammal spotter training for its bridge lookout personnel on ships and submarines. This training has been revamped and updated as the Marine Species Awareness Training (MSAT) and is provided to all applicable units. The lookout training program incorporates MSAT, which addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments, and general observation information, including more detailed information for spotting marine mammals. MSAT has been reviewed by NMFS and acknowledged as suitable training. MSAT would also be provided to the following personnel:

- Bridge personnel on ships and submarines – Personnel would continue to use the current marine mammal spotting training and any updates.

- Aviation units – Pilots and air crew personnel whose airborne duties during Anti-Submarine Warfare (ASW) operations include searching for submarine periscopes would be trained in marine mammal spotting. These personnel would also be trained on the details of the mitigation measures specific to both their platform and that of the surface combatants with which they are operating.

- Sonar personnel on ships, submarines, and ASW aircraft – Sonar operators aboard ships, submarines, and aircraft operating on the proposed USWTR would be trained in the details of the mitigation measures relative to their platform. Training would also target the specific actions to be taken if a marine mammal is observed.

6.1.2 Procedures

The following procedures would be implemented to maximize the ability of operators to recognize instances when marine mammals are in the vicinity.

6.1.2.1 General Maritime Protective Measures: Personnel Training

- All lookouts aboard platforms involved in ASW training activities would review the NMFS-approved MSAT material prior to the use of mid-frequency active sonar.

- All Commanding Officers, Executive Officers, and officers standing watch on the bridge, maritime patrol aircraft aircrews, and Anti-submarine Warfare ASW helicopter crews will complete MSAT material prior to conducting a training activity employing mid-frequency active sonar.

- Navy lookouts would undertake extensive training in order to qualify as a lookout in accordance with the Lookout Training Handbook (Naval Education and Training Command Manual [NAVEDTRA] 12968-D).

- Lookout training would include on-the-job instruction under the supervision of a qualified, experienced lookout. Following successful completion of this supervised training period, lookouts would complete the PQS program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects). This does not forbid personnel being trained as lookouts from inclusion in previous measures as long as supervisors monitor their progress and performance.

- Lookouts would be trained to quickly and effectively communicate within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

6.1.2.2 General Maritime Protective Measures: Lookout Responsibilities

- On the bridge of surface ships, there would always be at least three personnel on watch whose duties include observing the water surface around the vessel.

- In addition to the three personnel on watch on the bridge, all surface ships participating in ASW exercises would have at least two additional personnel on watch as lookouts at all times during the exercises.

- Personnel on lookout and officers on watch on the bridge shall have at least one set of binoculars available for each person to aid in the detection of marine mammals.

- On surface vessels equipped with mid-frequency active sonar, pedestal-mounted “Big Eye” (20 x 110) binoculars shall be present and would be maintained in good working order to assist in the detection of marine mammals near the vessel.

- Personnel on lookout shall follow visual search procedures employing a scanning methodology in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).

- Surface lookouts should scan the water from the ship to the horizon and be responsible for all contacts in their sector. In searching the assigned sector, the lookout should always start at the forward part of the sector and search aft (toward the back). To search and scan, the lookout should hold the binoculars steady so the horizon is in the top third of the field of vision and direct their eyes just below the horizon. The lookout should scan for approximately five seconds in as many small steps as possible across the field seen through the binoculars. They should search the entire sector through the binoculars in approximately five-degree steps, pausing between steps for approximately five seconds to scan the field of view. At the end of the sector search, the glasses would be lowered to allow the eyes to rest for a few seconds, and then the lookout should search back across the sector with the naked eye.

- After sunset and prior to sunrise, lookouts shall employ Night Lookout Techniques in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).

- At night, lookouts should not sweep the horizon with their eyes, as eyes do not perceive objects well when they are moving. Lookouts should scan the horizon in a series of short movements that would allow their eyes to come to periodic rests as they scan the sector. When visually searching at night, they should look a little to one side and out of the corners of their eyes, paying attention to the things on the outer edges of their field of vision.

- Personnel on lookout shall be responsible for informing the OOD of all objects or anomalies sighted in the water (regardless of the distance from the vessel), since any object or disturbance (e.g., trash, periscope, surface disturbance, discoloration) in the water may indicate a threat to the vessel and its crew or the presence of a marine species that may need to be avoided, as warranted.

6.1.2.3 Operating Procedures

- Helicopters shall observe/survey the vicinity of a planned ASW exercise ten minutes prior to dipping of sonobuoys.

- Commanding officers would make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible, consistent with the safety of the ship.

- All personnel using all instrumentation capable of passive acoustic sonar operation (including aircraft, surface ships, or submarines) shall monitor for marine mammal vocalizations and report the detection of any marine mammal to the appropriate watch station for dissemination and appropriate action. The Navy can detect sounds within the human hearing range due to an operator listening to the incoming sounds. Passive acoustic detection systems are used during all ASW activities. See Subchapter 6.1.2.5.1 for further description of passive acoustic detection.

- Units shall use trained lookouts to survey for marine mammals and sea turtles prior to commencement and during the use of active sonar.

- During operations involving active sonar, personnel shall use all available sensor and optical systems (such as night vision goggles to aid in the detection of marine mammals).

- Navy aircraft participating in exercises at sea shall conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

- Aircraft with deployed sonobuoys shall use only the passive capability of sonobuoys when marine mammals are detected within 183 m (600 ft) of the sonobuoy.

- Marine mammal detections by aircraft shall be immediately reported to the assigned Aircraft Control Unit (if participating) for further dissemination to ships in the vicinity of the marine species. This action shall occur when it is reasonable to conclude that the course of the ship will likely close the distance between the ship and the detected marine mammal.

- When marine mammals are detected by any means (aircraft, shipboard lookout, or acoustically) within 914 m (3,000 ft) of the sonar dome (the bow), the ship or submarine shall limit active transmission levels to at least 6 decibels (dB) below normal operating levels.

- Ships and submarines shall continue to limit maximum transmission levels by this 6 dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 1,829 m (6,000 ft) beyond the location of the last detection.

- Should a marine mammal be detected within 457 m (1,500 ft) of the sonar dome, active sonar transmissions shall be limited to at least 10 dB below the equipment’s normal operating level. Ships and submarines shall continue to limit maximum ping levels by this 10 dB factor until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 1,829 m (6,000 ft) beyond the location of the last detection.

- Should the marine mammal be detected within 183 m (600 ft) of the sonar dome, active sonar transmissions shall cease. Sonar shall not resume until the animal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 1,829 m (6,000 ft) beyond the location of the last detection.

- If the need for power-down should arise, as detailed above, Navy staff shall follow the requirements as though they were operating at 235 dB - the normal operating level (i.e., the first power-down shall be to 229 dB, regardless of the level above 235 db the sonar was being operated).

- Prior to start up or restart of active sonar, operators shall check that the shut down zone radius around the sound source is clear of marine mammals.

- Sonar levels (generally) – The Navy would operate sonar at the lowest practicable level, not to exceed 235 dB, except as required to meet tactical training objectives

- Helicopters shall not dip their sonar within 183 m (600 ft) of a marine mammal and would cease pinging if a marine mammal closes within 183 m (600 ft) after pinging has begun.

- Submarine sonar operators shall review detection indicators of close-aboard marine mammals prior to the commencement of ASW operations involving active sonar.

- Night vision devices shall be available to all Sailors and aircrews, for use as appropriate.

6.1.2.4 Special Conditions Applicable for Bow-riding Dolphins

If, after conducting an initial maneuver to avoid close quarters with dolphins, the ship concludes that dolphins are deliberately closing in on the ship to ride the vessel's bow wave, no further mitigation actions are necessary. While in the shallow-wave area of the vessel bow, dolphins are out of the main transmission axis of the active sonar.

6.1.2.5 Detection Probability and Mitigation Efficacy

The probability of visually detecting a marine animal is dependent upon two things. First, the animal and the observer must be in the same place at the same time. If the animal is not present, it cannot be seen (availability bias) (Marsh and Sinclair, 1989). Second, when the animal is in a position to be detected by an observer and the observer in a position to detect the animal, the observer must perceive the animal (perception bias) (Marsh and Sinclair, 1989). The factors affecting the detection of the animal may be probabilistically quantified as *g(0)*. That is, *g(0)* represents the chance that the animal will be available for detection (i.e., on the surface and in the observer's field of view) and that the observer will perceive the animal. A *g(0)* value of 1 indicates that 100 percent of the animals are detected; it is rare that this assumption holds true, as both perception and availability bias impact the overall value of *g(0)* for any given species.

Various factors are involved in estimating *g(0)*, including: sightability/detectability of the animal (species-specific behavior and appearance, school size, blow characteristics, dive characteristics, and dive interval); viewing conditions (sea state, wind speed, wind direction, sea swell, and glare); and observer (experience, fatigue, and concentration) and platform characteristics (pitch, roll, yaw, speed, and height above water). Thomsen et al. (2005) provide a complete and recent discussion of *g(0)*, factors that affect the detectability of the animals, and ideas on how to account for detection bias. It is important to note that *g(0)* as it is used here does not relate to the ability to identify an animal on any order, only that the animal will be detected.

6.1.2.5.1 Marine Mammals

In general, large whales are fairly easy to detect due to their large size and prominent blow (Taylor et al., 2007). Also relatively easy to detect are large groups of individuals, particularly gregarious delphinids that may be visible from a great distance due to the disturbance they make when moving across the surface of the water. Less easy to detect are marine mammals that spend a great deal of time at depth or whose presence on the surface is solitary and inconspicuous (Taylor et al., 2007).

Most information on pinnipeds is gleaned from studies done while individuals are hauled-out on land or on ice. Systematic at-sea sightings information is limited, so a *g(0)* value is available only for the harbor seal (Carretta et al., 2000). Pinnipeds have a low profile, no dorsal appendage, and small body size in comparison with most cetaceans, limiting accurate visual detection to sea states of less than Beaufort 2 (Carretta et al., 2000).

It is possible that not all marine mammals will be spotted using visual methods, so acoustic methods are often useful for augmenting detection efforts. Most marine mammals produce detectable acoustic signals related to almost every aspect of their life; in-water acoustic signals are produced mainly by cetaceans, though pinnipeds may make underwater sounds as well (Tyack et al., 2002). Although acoustic signal production varies depending on the species, age class, gender, and behavior (Tyack et al., 2002), these signals are produced commonly enough to allow detection through passive acoustic monitoring. For example, data suggest that sperm whales do not go longer than 40 minutes without producing some sort of sound (Teloni, 2005; Lewis et al., 2007). Mysticete whales vocalize at lower frequencies than toothed cetaceans. While passive listening will be useful in augmenting visual detection efforts, there are species that either may not produce sound or will not be heard while they are in the vicinity of the detection platform. Many species of toothed whales, including long-diving and cryptic species such as *Kogia* spp. and beaked whales, produce highly directional, ultrasonic sounds (Marten, 2000; Madsen and Wahlberg, 2007). Pinnipeds will not be detected acoustically.

Table 6-2

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Threatened/Endangered Cetacean Species			
Right whale (*Eubalaena* spp.)			
0.29-1.00**	U.S. Atlantic Coast	Shipboard	Palka, 2006
0.11-0.71	U.S. Atlantic Coast	Aerial	Hain et al., 1999
0.19-0.29	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.95	U.S. West Coast	Aerial	Forney et al., 1995
Humpback whale (*Megaptera novaeangliae*)			
0.19-0.21	U.S. Atlantic Coast	Shipboard	Palka, 2005a
0.90-1.00	U.S. West Coast	Shipboard	Barlow, 1995; Calambokidis and Barlow, 2004
0.95	U.S. West Coast	Aerial	Forney et al., 1995
0.26	Hawaii	Aerial	Mobley et al., 2001

Table 6-2 (cont'd)

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Threatened/Endangered Cetacean Species			
Blue whale (*Balaenoptera musculus*)			
0.41	U.S. West Coast	Aerial	Barlow et al., 1997; Carretta et al., 2000
0.9-1.00	U.S. West Coast	Shipboard	Barlow and Taylor, 2001
0.92	U.S. West Coast	Shipboard	Barlow and Forney, 2007; Forney, 2007
Sei whale (*Balaenoptera borealis*)			
0.92	U.S. West Coast	Shipboard	Barlow and Forney, 2007; Forney, 2007
Fin whale (*Balaenoptera physalus*)			
0.32-0.94	U.S. Atlantic Coast	Shipboard	Blaylock et al., 1995; Palka, 2006
0.19-0.29	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.90-1.00	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.95-0.98	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
0.90-1.00	Hawaii	Shipboard	Barlow, 2003b
Sperm whale (*Physeter macrocephalus*)			
0.28-0.57	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.19-0.29	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.53-1.00	U.S. West Coast	Shipboard	Barlow, 1995; Barlow and Gerrodette, 1996; Barlow and Sexton, 1996; Barlow, 2003a; Barlow and Taylor, 2005
0.95-0.98	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
0.87	Hawaii	Shipboard	Barlow, 2003b, 2006a
0.32	Antarctic	Shipboard	Kasamatsu and Joyce, 1995

Table 6-2 (cont'd)

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Non-Threatened/Non-Endangered Cetacean Species			
Minke whale (*Balaenoptera acutorostrata*)			
0.31-0.70	U.S. Atlantic Coast	Shipboard	Blaylock et al., 1995; Palka, 2006
0.19-0.29	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.25-0.90	Eastern North Atlantic	Shipboard	Butterworth and Borchers, 1988; Øien, 1990; Schweder et al., 1991, 1992, 1997; Schweder and Høst, 1992; Skaug and Schweder, 1999; Skaug et al., 2004
0.84	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.95-0.98	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
0.63-0.83	Antarctic	Shipboard	Doi et al., 1982; IWC 1982
Bryde's whale (*Balaenoptera edeni*)			
0.90-1.00	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.90	Hawaii	Shipboard	Barlow, 2003b, 2006
Kogia spp.			
0.29-0.55**	U.S. Atlantic Coast	Shipboard	Palka, 2006
0.19-0.79	U.S. West Coast	Shipboard	Barlow, 1995; Barlow and Sexton, 1996; Barlow, 1999, 2003a
0.35	Hawaii	Shipboard	Barlow, 2003b, 2006

Table 6-2 (cont'd)

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Non-Threatened/Non-Endangered Cetacean Species			
Ziphiidae (Beaked Whales)			
0.46-0.51	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.19-0.21	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.13-1.00	U.S. West Coast	Shipboard	Barlow, 1995; Barlow and Sexton, 1996; Barlow, 1999; Carretta et al., 2001; Barlow, 2003a; Barlow et al., 2006
0.23-0.45**	Hawaii	Shipboard	Barlow, 2003b, 2006
0.27	Antarctic	Shipboard	Kasamatsu and Joyce, 1995
0.95-0.98	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
Bottlenose dolphin (*Tursiops truncatus*)			
0.62-0.99	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.58-0.77	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.74-1.00	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.67-0.96	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Spinner dolphin (*Stenella longirostris*)			
0.61-0.76**	U.S. Atlantic Coast	Shipboard	Palka, 2006
0.77-1.0	U.S. West Coast	Shipboard	Barlow, 2003a
0.77-1.0	Hawaii	Shipboard	Barlow, 2003b, 2006
Clymene dolphin (*Stenella clymene*)			
None available.			
Pantropical spotted dolphin (*Stenella attenuata*)			
0.37-0.94**	U.S. Atlantic Coast	Shipboard	Palka, 2006
0.77-1.00	U.S. West Coast	Shipboard	Barlow, 2003a
0.76-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Atlantic spotted dolphin (*Stenella frontalis*)			
0.37-0.94**	U.S. Atlantic Coast	Shipboard	Palka, 2006

Table 6-2 (cont'd)

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Non-Threatened/Non-Endangered Cetacean Species			
Striped dolphin (*Stenella coeruleoalba*)			
0.61-0.77	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.77-1.00	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.76-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Common dolphin (*Delphinus delphis*)			
0.52-0.95	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.58-0.77	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.79-0.81	Eastern North Atlantic	Shipboard	Cañadas, et al. 2004
0.77-1.0	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.67-0.96	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
Rough-toothed dolphin (*Steno bredanensis*)			
0.74-1.00	U.S. West Coast	Shipboard	Barlow, 2003a
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Fraser's dolphin (*Lagenodelphis hosei*)			
0.76-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
White-sided dolphin (*Lagenorhynchus acutus* and *L. obliquidens*)			
0.27-0.38**	U.S. Atlantic Coast	Shipboard	Palka, 2006
0.58-0.77	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.77-1.00	U.S. West Coast	Shipboard	Barlow, 1995, 2003a
0.67-0.96	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
White-beaked dolphin (*Lagenorhynchus albirostris*)			
None available.			
Risso's dolphin (*Grampus griseus*)			
0.51-0.84	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.58-0.77	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.74-1.00	U.S. West Coast	Shipboard	Barlow ,1995, 2003a
0.67-0.96	U.S. West Coast	Aerial	Forney and Barlow, 1993; Forney et al., 1995
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006

Table 6-2 (cont'd)

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Non-Threatened/Non-Endangered Cetacean Species			
False killer whale (*Pseudorca crassidens*)			
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Pygmy killer whale (*Feresa attenuata*)			
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Killer whale (*Orcinus orca*)			
0.90	U.S. West Coast	Shipboard	Barlow, 2003a
0.95-0.98	U.S. West Coast	Aerial	Forney et al., 1995
0.90	Hawaii	Shipboard	Barlow, 2003b, 2006
0.96	Antarctic	Shipboard	Kasamatsu and Joyce, 1995
Melon-headed whale (*Peponocephala electra*)			
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
Pilot whale (*Globicephala* spp.)			
0.48-0.67	U.S. Atlantic Coast	Shipboard	Palka, 2005a, 2006
0.19-0.29	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.74-1.00	U.S. West Coast	Shipboard	Barlow, 2003a
0.74-1.00	Hawaii	Shipboard	Barlow, 2003b, 2006
0.93	Antarctic	Shipboard	Kasamatsu and Joyce, 1995
Harbor porpoise (*Phocoena phocoena*)			
0.35-0.73	U.S. Atlantic Coast	Shipboard	Palka, 1995, 1996, 2006
0.24-0.49	U.S. Atlantic Coast	Aerial	Palka, 2005b
0.41-0.71	Eastern North Atlantic	Aerial	Grünkorn et al., 2005
0.08-0.85	U.S. West Coast	Aerial	Barlow et al., 1988; Calambokidis et al., 1993a; Forney et al., 1995; Laake et al., 1997; Carretta et al., 2001, 2007
0.54-0.79	U.S. West Coast	Shipboard	Calambokidis et al., 1993b; Barlow, 1995; Carretta et al., 2001

Table 6-2 (cont'd)

Range of Estimates for g(0) for Marine Mammal Species Found in the USWTR Study Area

g(0)*	Location	Platform	Source
Non-Threatened/Non-Endangered Pinniped Species			
Harbor seal (*Phoca vitulina*)			
0.28	U.S. West Coast	Aerial	Barlow et al., 1997; Carretta et al., 2000

* A *g(0)* value of 1.00 indicates that 100 percent of the animals are detected; it is rare that this assumption holds true. Departures of *g(0)* from 1.00 can be attributed to either perception bias or availability bias.
** These numbers were either determined by the source or applied by the source for abundance/density estimation analyses in the particular geographic location.

6.1.2.5.2 Sea Turtles

The detection probability of sea turtles is generally lower than that of cetaceans. Sea turtles often spend over 90 percent of their time underwater (e.g., Byles, 1988; Renaud and Carpenter, 1994; Mansfield and Musick, 2003) and are not visible more than one or two meters below the surface (Mansfield, 2006). Shoop and Kenney (1992) postulated that, due to the dive behavior of sea turtles, marine surveys underestimate the total number of animals in a given area by as much as an order of magnitude. This suggests that standard visual observation efforts may be less effective in detecting sea turtles than they are in detecting cetaceans. Sea turtles also are much smaller than cetaceans, so the effective distance from which they can be seen (from both surface and aerial platforms) is smaller (300 m [984 ft] for turtles versus over a kilometer for large whales or gregarious delphinids; Musick et al., 1984). Shipboard surveys designed for sighting marine mammals are adequate for detecting large sea turtles (e.g., adult leatherbacks) but usually not the smaller-sized turtles (e.g., juveniles, *Lepidochelys* spp.). Pelagic juveniles may be especially difficult to detect. Aerial detection may be more effective in spotting sea turtles on the surface, particularly in calm seas and clear water, but it is possible that the smallest age classes are not detected even in good conditions (Marsh and Saalfeld, 1989). Visual detection of sea turtles, especially small turtles, is further complicated by their startle behavior in the presence of ships. Turtles on the surface may react to the presence of a vessel (dive) before it is detected by shipboard or aerial observers (Kenney, 2005). However, sea turtle reaction time is reduced in proportion to increasing vessel speeds (Hazel et al., 2007).

There have been few dedicated surveys for sea turtles. There is no information available on specific *g(0)* values for turtles. Most of these studies have used mathematical models to calculate the proportion of surfaced turtles to submerged turtles based on the proportion of time sea turtles are expected to spend at the surface (obtained from tracking or tagging data). Byles (1988) found that for every loggerhead observed on the surface in Chesapeake Bay, approximately 19 were present but unobservable. Mansfield (2006) found that sea turtles spent more time at the surface during the spring than during the summer within the Chesapeake Bay. Therefore, the 1:19 (at surface/ under the surface) ratio would change depending on the season. However, sea turtles only spend a portion of the year in Chesapeake Bay and their surfacing behavior may be different than that of year-round residents in other locations. Not only are there no specific estimates of *g(0)* for turtles, but it is likely that the value shifts significantly depending on species, age class, season and geographic region.

Visual mitigation efforts for sea turtles will probably detect only those individuals that are very large or that spend a significant portion of their time at the surface. Sea turtles will not be detected acoustically.

6.1.2.6 Potential Protective Measures Under Development

No mitigation effort will be 100 percent effective, just as no scientific survey is able to detect every animal. It is possible that some species, particularly those that are deep-diving or cryptic, may not be detected by either visual or passive acoustic means during Navy training on the proposed USWTR. In order to address potential impacts to undetected animals, the Navy is coordinating with the NMFS to improve mitigation effectiveness.

Evolving and novel approaches in acoustic detection and localization may be useful for mitigation and monitoring. These developing new technologies may help detect marine mammals. The Navy is currently funding a large-scale, behavioral study of beaked whales in the Bahamas to better understand their behavior as it relates to the presence of sound such as MFA sonar. In addition, the Navy is working to develop the capability to detect and localize vocalizing marine mammals using installed sensors. Underwater hydrophones such as those associated with underwater instrumented ranges may ultimately be useful in both detecting and localizing marine mammals (Ko et al., 2008). However, based on the current status of acoustic monitoring science, it is not yet possible to use installed systems as mitigation tools. As this science develops, it will be incorporated in the USWTR mitigation plan.

In addition, the Navy is also actively engaged in acoustic monitoring research involving a variety of methodologies (e.g., underwater gliders); to date, none of the methodologies have been developed to the point where they could be used as an actual mitigation tool. The Navy will continue to coordinate passive monitoring and detection research specific to the proposed use of active sonar. As technology and methodologies become available, their applicability and viability will be evaluated for incorporation into this mitigation plan.

6.1.3 Conservation Measures

6.1.3.1 Monitoring

The U.S. Navy is committed to demonstrating environmental stewardship while executing its National Defense mission and is responsible for compliance with a suite of Federal environmental and natural resources laws and regulations that apply to the marine environment. A number of monitoring plans are currently being developed for protected marine species (primarily marine mammals and sea turtles) as part of the environmental planning and regulatory compliance process associated with a variety of training actions and range complexes. The purpose of these monitoring plans is to assess the effects of training activities on marine species. The primary focus of these monitoring plans will be on effects to individuals but data may also support investigation of potential population-level trends in marine species distribution, abundance, and habitat use in various range complexes and geographic locations where Navy training occurs.

The Navy is developing an Integrated Comprehensive Monitoring Program (ICMP) for marine species in order to establish the overarching framework and oversight that will facilitate the collection and synthesis of information and data from the various monitoring efforts being implemented. The ICMP will compile data from range-specific monitoring efforts as well as research and development (R&D) studies that are fully or partially Navy-funded. While the ICMP is not a regulatory requirement, it will facilitate the synthesis of information across multiple monitoring efforts and help to coordinate the most efficient use of limited resources in order to address monitoring concerns navy-wide. Although the ICMP is intended to apply to all Navy training, use of MFA sonar in training, testing, and research, development, test, and evaluation (RDT&E) will comprise a major component of the overall program.

The primary goals of the ICMP are:

- To monitor Navy training exercises, especially those involving active sonar and underwater detonations, for compliance with the terms and conditions of ESA Section 7 consultations or MMPA authorizations.
- To minimize exposure of protected species to sound levels from active sonar currently considered to result in harm/harassment.
- To collect data to support estimating the number of individuals exposed to sound levels above current regulatory thresholds.
- To assess the efficacy of the Navy's current marine species mitigation.
- To assess the practicality and effectiveness of potential future mitigation tools and techniques.
- To document trends in species distribution and abundance in Navy training areas through focused longitudinal monitoring efforts.
- To add to the knowledge base on potential behavioral and physiological effects to marine species from active sonar.

The ICMP and adaptive management tool will include:

- A method for prioritizing monitoring projects that clearly describes the characteristics of a proposal that factor into its priority.

- A method for annually reviewing, with NMFS, monitoring results, Navy R&D, and current science to use for potential modification of mitigation or monitoring methods.

- A detailed description of the Monitoring Workshop to be convened in 2011 and how and when Navy/NMFS will subsequently utilize the findings of the Monitoring Workshop to potentially modify subsequent monitoring and mitigation.

- An adaptive management plan.

The ICMP will provide a comprehensive structure and serve as the basis for establishing monitoring plans for individual range complexes and specific training activities. Specific training exercise plans will be focused on short-term monitoring and mitigation for individual training activities. Each training event will be evaluated to determine if it represents an appropriate monitoring opportunity within the ICMP framework. Due to the scale (spatial, temporal, and operational) of various training activities, not every event will present optimum opportunity for concentrated monitoring and as a result various levels of effort and resources will be associated with individual exercises. The overall approach of the ICMP is to target the majority of available monitoring resources on a limited number of opportunities with best potential for high quality data collection rather than attempting to apply a thin blanket of monitoring over the entirety of Navy training.

Data collection methods will be standardized across the program to the extent possible to provide the best opportunity for pooling data from multiple regions. Some methods may be universally applicable; however, some may be utilized only in specific locations where conditions are most appropriate. For example, in Hawaii, there is significant baseline data on odontocetes from tagging, which can be used to provide context for tagging data collected during training events. The Navy's overall monitoring approach will seek to leverage and build upon existing research efforts whenever possible.

By using a combination of monitoring techniques or tools appropriate for the species of concern, the type of Navy activities conducted in the area, sea state conditions, and the appropriate spatial extent, the detection, localization, and observation of marine species can be maximized. The ICMP will evaluate the range of potential monitoring techniques that can be tailored to any Navy range or exercise and the appropriate species of concern. The primary tools available for monitoring include the following:

- **Visual Observations –** Surface vessel and aerial survey platforms can provide data on both long term population trends (abundance and distribution) as well as occurrence immediately before, during, and after training events. In addition, visual observation has the potential to collect information related to behavioral response of marine species to Navy training activities. Both Navy personnel (lookouts) and independent visual observers (Navy biologists) will be used from a variety of platforms for monitoring as appropriate and logistically feasible.

- **Passive Acoustic Monitoring –** Autonomous Acoustic Recorders (moored buoys), High Frequency Acoustic Recording Packages (HARPS), sonobuoys, passive acoustic towed arrays, shipboard passive sonar, and Navy Instrumented Acoustic Ranges can provide data on presence/absence as well as localization, identification and tracking in some cases. Passive acoustic observations are particularly important for species that are difficult to detect visually or when conditions limit the effectiveness of visual monitoring. Instrumented navy ranges present a unique opportunity to take advantage of infrastructure that would otherwise not be available for monitoring such a large area. The Marine Mammal Monitoring on Navy Ranges (M3R) program takes advantage of this opportunity and may support long-term data collection at specific fixed sites.

- **Tagging –** Tagging is an important tool for examining the movement patterns and diving behavior of cetaceans. Sensors can be used that measure location, swim velocity, orientation, vocalizations, as well as record received sound levels. Tagging with sophisticated digital acoustic recording tags (D-tags) may also allow direct monitoring of behaviors not readily apparent to surface observers. D-tags were deployed as part of a behavioral response study (Claridge, 2008) initiated in 2007 at the AUTEC range in the Bahamas to identify behavioral mechanisms related to anthropogenic sound exposure. This tagging study continued through 2008 and is currently being conducted.

- **Photo identification and tagging of animals –** Photo identification contributes to understanding of movement patterns and stock structure which is important to determine how potential effects may relate to individual stocks or populations.

- **Oceanographic and environmental data collection –** Physical and environmental data related to habitat parameters is necessary for analyzing distribution patterns, developing predictive habitat and density models, and better understanding habitat use.

In addition, the ICMP will propose to continue or initiate studies of behavioral response, abundance, distribution, habitat utilization, etc. for species of concern using a variety of methods which may include visual surveys, passive and acoustic monitoring, radar and data logging tags (to record data on acoustics, diving and foraging behavior, and movements). This work will help to build the collective knowledgebase on the geographic and temporal extent of key habitats and provide baseline information to account for natural perturbations such as El Niño or La Niña events as well as establish baseline information to determine the spatial and temporal extent of reactions to Navy operations, or indirect effects from changes in prey availability and distribution.

In 2005, the Navy contracted with a consortium of researchers from Duke University, University of North Carolina at Wilmington, University of St. Andrews, and NMFS Northeast Fisheries Science Center to conduct a pilot study analysis and subsequently develop a survey and monitoring plan in support of the planned USWTR Training activities. This survey and monitoring plan prescribes the recommended approach for data collection, including surveys (such as aerial/shipboard, frequency, and spatial extent) and data analysis (standard line-transect, spatial modeling) necessary to establish a fine-scale seasonal baseline of the distribution and abundance of protected species.

The baseline data collection portion of the program began in June 2007 and includes coordinated aerial, shipboard, and passive acoustic surveys, as well as deployment of high-frequency acoustic recording packages to supplement the traditional visual surveys. This intensive data collection effort is planned to continue in support of USWTR.

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead or floating marine mammals that may occur at any time during or within 24 hours after completion of mid-frequency active sonar use associated with ASW training activities. The Navy will submit a report to the Office of Protected Resources, NMFS, within 120 days of the completion of a Major Exercise. This report must contain a discussion of the nature of the effects, if observed, based on both modeled results of real-time events and sightings of marine mammals.

In combination with previously discussed mitigation and protective measures, exercise-specific implementation plans developed under the ICMP will ensure thorough monitoring and reporting of USWTR training activities. A Letter of Instruction, Mitigation Measures Message, or Environmental Annex to the Operational Order will be issued prior to each exercise to further disseminate the personnel training requirement and general marine mammal protective measures including monitoring and reporting.

The Navy shall abide by the Stranding Response Plan to include the following measures:

(A) Shutdown Procedures– When an Uncommon Stranding Event (USE – as defined in the regulations) occurs during a Major Training Exercise the Navy shall implement the procedures described below.

> (1) The Navy shall implement a Shutdown (as defined in the regulations) when advised by a NMFS Office of Protected Resources Headquarters Senior Official designated in the Stranding Communication Protocol that a USE involving live animals has been identified and that at least one live animal is located in the water. NMFS and Navy will maintain a

dialogue, as needed, regarding the identification of the USE and the potential need to implement shutdown procedures.

(2) Any shutdown in a given area shall remain in effect in that area until NMFS advises the Navy that the subject(s) of the USE at that area die or are euthanized, or that all live animals involved in the USE at that area have left the area (either of their own volition or herded).

(3) If the Navy finds an injured or dead animal of any species other than North Atlantic right whale floating at sea during an MTE, the Navy shall notify NMFS immediately or as soon as operational security considerations allow. The Navy shall provide NMFS with species or description of the animal (s), the condition of the animal(s) including carcass condition if the animal(s) is/are dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). Based on the information provided, NMFS shall determine if, and advise the Navy whether, a modified shutdown is appropriate on a case-by-case basis.

(4) If the Navy finds an injured (or entangled) North Atlantic right whale floating at sea during an MTE, the Navy shall implement shutdown procedures 14 NM (26 km) around the animal immediately (without waiting for notification from NMFS). The Navy shall then notify NMFS (pursuant to the Communication Protocol) immediately or as soon as operational security considerations allow. The Navy shall provide NMFS with species or description of the animal (s), the condition of the animal (s) including carcass condition if the animal(s) is/are dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). Subsequent to the discovery of the injured whale, any Navy platforms in the area shall report any North Atlantic right whale sightings to NMFS (or to a contact that can alert NMFS as soon as possible). Based on the information provided, NMFS may initiate/organize an aerial survey (by requesting the Navy’s assistance pursuant to the memorandum of agreement (MOA) or by other available means) to see if other North Atlantic right whales are in the vicinity. Based on the information provided by the Navy and, if necessary, the outcome of the aerial surveys, NMFS shall determine whether a continued shutdown is appropriate on a case-by-case basis. Though it will be determined on a case-by-case basis after Navy/NMFS discussion of the situation, NMFS anticipates that the shutdown will continue within 14 NM (26 km) of a live, injured/entangled North Atlantic right whale until the animal dies or has not been seen for at least 3 hours (either by NMFS staff attending the injured animal or Navy personnel monitoring the area around where the animal was last sighted).

(5) If the Navy finds a dead North Atlantic right whale floating at sea during an MTE, the Navy shall notify NMFS (pursuant to AFAST Stranding Communication Protocol) immediately or as soon as operational security considerations allow. The Navy shall provide NMFS with species or description of the animal (s), the condition of the animal (s) including carcass condition if the animal(s) is/are dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available). Subsequent to

the discovery of the dead whale, if the Navy is operating sonar in the area they shall use increased vigilance (in looking for North Atlantic right whales) and all platforms in the area shall report sightings of North Atlantic right whales to NMFS as soon as possible. Based on the information provided, NMFS may initiate/organize an aerial survey (by requesting the Navy's assistance pursuant to the MOA or by other available means) to see if other North Atlantic right whales are in the vicinity. Based on the information provided by the Navy and, if necessary, the outcome of the aerial surveys, NMFS will determine whether any additional mitigation measures are necessary on a case-by-case basis.

(6) In the event, following a USE, that: a) qualified individuals are attempting to herd animals back out to the open ocean and animals are not willing to leave, or b) animals are seen repeatedly heading for the open ocean but turning back to shore, NMFS and the Navy shall coordinate (including an investigation of other potential anthropogenic stressors in the area) to determine if the proximity of MFAS/HFAS training activities or explosive detonations, though farther than 14 NM (26 km) from the distressed animal(s), is likely contributing to the animals' refusal to return to the open water. If so, NMFS and the Navy will further coordinate to determine what measures are necessary to improve the probability that the animals will return to open water and implement those measures as appropriate.

(B) Within 72 hours of NMFS notifying the Navy of the presence of a USE, the Navy shall provide available information to NMFS (per the Communication Protocol) regarding the location, number and types of acoustic/explosive sources, direction and speed of units using MFAS/HFAS, and marine mammal sightings information associated with training activities occurring within 80 nm (148 km) and 72 hours prior to the USE event. Information not initially available regarding the 80 NM (148 km), 72 hour period prior to the event will be provided as soon as it becomes available. The Navy will provide NMFS investigative teams with additional relevant unclassified information as requested, if available.

(C) Memorandum of Agreement (MOA) – The Navy and NMFS shall develop a MOA, or other mechanism consistent with federal fiscal law requirements (and all other applicable laws), that will establish a framework whereby the Navy can (and provide the Navy examples of how they can best) assist NMFS with stranding investigations in certain circumstances.

6.1.3.2 Research

The Navy provides a significant amount of funding and support to marine research through a variety of organizations. From FY04 to FY08, the Navy provided over $94 million to universities, research institutions, federal laboratories, private companies, and independent researchers around the world for marine life research. During this same time period, the DoD contributed nearly $6 million for a total of $100 million in marine life research projects. These projects include basic science efforts, such as baseline surveys, and do not include monitoring surveys or environmental planning document preparation (DoN, 2008b). In FY08 alone, the Navy will spend over $26 million and the DoD almost $1 million towards this effort (DoN, 2008b). Currently, the Navy has budgeted nearly $22 million and the DoD has budgeted a half a million dollars for continued marine mammal research in FY09 (DoN, 2008b). Major topics of Navy-supported research include the following:

- Better understanding of marine species distribution and important habitat areas,
- Developing methods to detect and monitor marine species before and during training,
- Understanding the effects of sound on marine mammals, sea turtles, fish, and birds, and
- Developing tools to model and estimate potential effects of sound.

This research is directly applicable to USWTR training activities, particularly with respect to the investigations of the potential effects of underwater noise sources on marine mammals and other protected species. Proposed training activities employ sonar and underwater explosives, which introduce sound into the marine environment.

The Marine Life Sciences Division of the Office of Naval Research currently coordinates six programs that examine the marine environment and are devoted solely to studying the effects of noise and/or the implementation of technology tools that will assist the Navy in studying and tracking marine mammals. The six programs are as follows:

1. Environmental Consequences of Underwater Sound,
2. Non-Auditory Biological Effects of Sound on Marine Mammals,
3. Effects of Sound on the Marine Environment,
4. Sensors and Models for Marine Environmental Monitoring,
5. Effects of Sound on Hearing of Marine Animals, and
6. Passive Acoustic Detection, Classification, and Tracking of Marine Mammals.

The Navy has also developed the technical reports referenced within this document, which include the Marine Resource Assessments and the Navy OPAREA Density Estimates (NODE) reports. Furthermore, research cruises by the NMFS and by academic institutions have received funding from the U.S. Navy. For instance, the ONR contributed financially to the Sperm Whale Seismic Survey (SWSS) in the Gulf of Mexico, coordinated by Texas A&M. The goals of the SWSS are to examine effects of the oil and gas industry on sperm whales and what mitigations would be employed to minimize adverse effects to the species. All of this research helps in understanding the marine environment and the effects that may arise from the use of underwater noise in the Gulf of Mexico and western North Atlantic Ocean.

The Navy has sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops brought together acoustic experts and marine biologists from the Navy and other research organizations to present

- Security clearance issues would have to be overcome to allow non-Navy observers onboard as exercise participants.

- Some training periods will span one or more 24-hour periods, with operations underway continuously in that timeframe. It is not feasible to maintain non-Navy surveillance of these operations, given the number of non-Navy observers that would be required onboard.

- Surface ships having active mid-frequency sonar have limited berthing capacity. As exercise planning includes careful consideration of this limited capacity in the placement of exercise controllers, data collection personnel, and Afloat Training Group personnel on ships involved in the exercise. Inclusion of non-Navy observers onboard these ships would require that in some cases there would be no additional berthing space for essential Navy personnel required to fully evaluate and efficiently use the training opportunity to accomplish the exercise objectives.

- The vast majority (90%) of USWTR training events involves an aerial asset with crews specifically training to hone their detection of objects in the water, and the capability of sighting from both surface and aerial platforms provides excellent survey capabilities using the Navy's existing exercise assets.

• Surveying the USWTR prior to initiating exercises to ensure that the area is devoid of marine mammals.

    - Contiguous ASW events may cover many square miles. The number of civilian ships and/or aircraft required to monitor the area of these events would be considerable. It is not feasible to survey or monitor the large exercise areas in the time required ensuring these areas are devoid of marine mammals. Also, since marine mammals are likely to move freely into or out of an area, surveys done prior to an event could easily become irrelevant.

    - Survey during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, most of the training events take place far from land, limiting both the time available for civilian aircraft to be in the exercise area and presenting a concern should aircraft mechanical problems arise.

    - Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely fixed and are instead based on the free-flow data and information on current acoustic monitoring research efforts and to evaluate the potential for incorporating similar technology and methods on instrumented ranges. However, acoustic detection, identification, localization, and tracking of individual animals still requires a significant amount of research effort to be considered a reliable method for marine mammal monitoring. The Navy supports research efforts on acoustic monitoring and will continue to investigate the feasibility of passive acoustics as a potential mitigation and monitoring tool.

Recently, a workshop was held to discuss the research required to understand the impact of tactical mid-frequency sonar transmission on fish, fisheries and fisheries habitat. Workshop participants included personnel from the Navy, academic universities, and NOAA Fisheries Service, who were selected based on their expertise in acoustics, fish hearing and fisheries biology. The objective of the workshop was to describe the range of scientific concerns regarding the effects of Navy training activities using tactical mid-frequency active sonar on fish and fisheries resources and to distill these concerns into a long-term research and development plan. The priorities of the workshop included larval fish effects, hearing capabilities, small pelagic and soniferous fish behavior and potential effects to fisheries.

Overall, the Navy will continue to fund ongoing marine mammal research, and is planning to coordinate long term monitoring/studies of marine mammals on various established ranges and operating areas. The Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include mitigation and monitoring programs; data sharing with NMFS and via the literature for research and development efforts; and future research as described previously.

6.1.4 Coordination and Reporting

The Navy would coordinate with NMFS Stranding Coordinators for any unusual marine mammal behavior. This includes any stranding, beached live/dead, or floating marine mammals that may occur coincident with Navy training activities.

These mitigation measures have been developed in full consideration of the recommendations of the joint National Oceanic and Atmospheric Administration (NOAA) / Navy report on the Bahamas marine mammal stranding event (NOAA and DoN, 2001).

6.2 Protective Measures Related to Vessel Transit and North Atlantic Right Whales

The proposed USWTR would involve vessel movements from homeports along the eastern U.S. from Connecticut to Florida. The Navy recognizes the potential for interaction (ship strike) with North Atlantic right whales during vessel transits to and from homeports and the proposed

USWTR, as well as during range activities. Therefore, Navy protective measures for both the Mid-Atlantic region and the Southeast region of the U.S. are detailed in this section.

6.2.1 Mid-Atlantic, Offshore of the Eastern United States

For purposes of these measures, the mid-Atlantic is defined broadly to include ports south and east of Block Island Sound southward to South Carolina. The procedure described below would be established as protective measures for Navy vessel transits during North Atlantic right whale migratory seasons near ports located off the western North Atlantic, offshore of the eastern United States. The mitigation measures would apply to all Navy vessel transits, including those vessels that would transit to and from the proposed USWTR.

Seasonal migration of North Atlantic right whales is generally described by NMFS as occuring from October 15th through April 30th, when the whales migrate between feeding grounds farther north and calving grounds farther south. The Navy mitigation measures have been established in accordance with rolling dates identified by NMFS consistent with these seasonal patterns.

NMFS has identifed ports located in the western Atlantic Ocean, offshore of the eastern United States, where vessel transit during North Atlantic right whale migration is of highest concern for potential ship strike. The ports include the Hampton Roads entrance to the Chesapeake Bay, which includes the concentration of Atlantic Fleet vessels in Norfolk, Virginia. Navy vessels are required to use extreme caution and operate at a slow, safe speed consistent with mission and safety during the months indicated in Table 6-3 and within a 37 km (20 NM) arc (except as noted) of the specified reference points.

- During the months indicated in Table 6-3, Navy vessels would 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 not specifically identified above.

- All surface(d) units transiting within 56 km (30 NM) of the coast in the mid-Atlantic would ensure at least two lookouts are posted, including at least one lookout that has completed required MSAT training.

- Navy vessels would not knowingly approach any whale head on and would maneuver to keep at least 457 m (1,500 ft) away from any observed whale, consistent with vessel safety.

Table 6-3

Locations and Time Periods When Navy Vessels Are Required to Reduce Speeds
(Relevant to North Atlantic Right Whales)

Region	Months	Port Reference Points
South and East of Block Island	Sep-Oct and Mar-Apr	37 km (20 nm) seaward of line between 41-4.49N 071-51.15W and 41-18.58N 070-50.23W
New York / New Jersey	Sep-Oct and Feb-Apr	40-30.64N 073-57.76W
Delaware Bay (Philadelphia)	Oct-Dec and Feb-Mar	38-52.13N 075-1.93W
Chesapeake Bay (Hampton Roads and Baltimore)	Nov-Dec and Feb-Apr	37-1.11N 075-57.56W
North Carolina	Dec-Apr	34-41.54N 076-40.20W
South Carolina	Oct-Apr	33-11.84N 079-8.99W 32-43.39N 079-48.72W

Additionally, all Navy vessels assume a slow, safe speed (on the range and in transit) that is dependent upon the situation, would allow the ship to maneuver around any navigational hazards (including marine mammals), and relies upon the judgment and experience of the vessel's captain. Navy vessels will additionally abide by the USCG Navigation Rules (USCG, 2008b) while traveling and using the USWTR range. Vessels may operate in a manner outside the Navigation Rules when the training exercise requires realistic combat maneuvers.

6.2.2 Southeast Atlantic, Offshore of the Eastern United States

For purposes of these measures, the southeast encompasses sea space from Charleston, South Carolina, southward to Sebastian Inlet, Florida, and from the coast seaward to 148 km (80 NM) from shore. The mitigation measures described in this section were developed specifically to protect the North Atlantic right whale during its calving season (typically from December 1st through March 31st). During this period, North Atlantic right whales give birth and nurse their calves in and around federally designated critical habitat off the coast of Georgia and Florida. This critical habitat is the area from 31-15N to 30-15N extending from the coast out to 28 km (15 NM), and the area from 28-00N to 30-15N from the coast out to 9 km (5 NM). All mitigation measures that apply to the critical habitat also apply to an associated area of concern which extends 9 km (5 NM) seaward of the designated critical habitat boundaries.

Prior to transiting or training in the critical habitat or associated area of concern, ships would contact Fleet Area Control and Surveillance Facility, Jacksonville, to obtain latest whale sighting and other information needed to make informed decisions regarding safe speed and path of intended movement. Subs would contact Commander, Submarine Group Ten for similar information.

Specific mitigation measures related to activities occurring within the critical habitat or associated area of concern during the calving season include the following:

- When transiting within the critical habitat or associated area of concern, vessels would exercise extreme caution and proceed at a slow safe speed. The speed would be the slowest safe speed that is consistent with mission, training, and operations.
- Speed reductions (adjustments) are required when a whale is sighted by a vessel or when the vessel is within 9 km (5 NM) of a reported sighting less than 12 hours old.
- Additionally, circumstances could arise where, in order to avoid North Atlantic right whale(s), speed reductions could mean vessel must reduce speed to a minimum at which it can safely keep on course or vessels could come to an all stop.
- Vessels would avoid head-on approach to North Atlantic right whale(s) and would maneuver to maintain at least 457 m (1,500 ft) of separation from any observed whale if deemed safe to do so. These requirements would not apply if a vessel's safety is threatened, such as when change of course would create an imminent and serious threat to person, vessel, or aircraft, and to the extent vessels are restricted in the ability to maneuver.
- Ships would not transit through the critical habitat or associated area of concern in a North-South direction.
- Ship, surfaced subs, and aircraft would report any whale sightings to Fleet Area Control and Surveillance Facility, Jacksonville, by most convenient and fastest means. Sighting report would include the time, latitude/longitude, direction of movement and number and description of whale(s) (i.e., adult/calf).

6.3 Mitigation Measures Related to Landside Facilities

6.3.1 Site A

The only potential adverse landside environmental impacts anticipated at NS Mayport beach could be to protected species. There could be temporary impacts to the nesting activities of the federally threatened loggerhead sea turtle, and endangered green sea and leatherback turtles if *installation occurs during nesting months. Under such circumstances, consultation with the USFWS would be conducted before initiating any construction activities. Current conservation measures in place at NS Mayport beach would minimize or eliminate the potential for adverse impact to the nesting activities of loggerhead, green sea, and leatherback turtles. These include marking known sea turtle nesting areas with protective fencing and avoiding disturbance of those areas. Pre-construction surveys would be conducted for piping plover nesting activity, and if observed, appropriate avoidance measures would prevent impacts to piping plover. It is anticipated that no additional mitigation measures would be required at the proposed Alternative A landfall site.*

6.3.2 Site B

The proposed action could cause temporary impacts to the nesting activities of the federally threatened loggerhead sea turtles on Sullivan Island if installation were to occur during nesting months; however, under such circumstances, consultation with the USFWS would be conducted before initiating any construction activities. Conservation measures implemented through such consultation would minimize or eliminate the potential for adverse impact. These conservation measures could include marking known sea turtle nesting areas with protective fencing and avoiding disturbance of those areas.

Consultation with the U.S. National Park Service would be conducted to avoid impacts to the Ft. Moultrie historic site as a result of the installation of the trunk cable and construction of the CTF.

6.3.3 Site C

The only potential adverse landside environmental impacts anticipated at Onslow Beach could be to protected species. There could be temporary impacts to the nesting activities of the federally threatened loggerhead sea turtle and the federally endangered green sea turtle if installation occurs during nesting months; however, under such circumstances, consultation with the USFWS would be arranged before initiating any construction activities. Further, existing conservation measures implemented at Camp Lejeune would be followed to the maximum extent practicable. These measures are documented in the biological opinion for Onslow Beach and include (USFWS, 2002):

- *Prior to construction, the presence or absence of turtle nests in the project area would be confirmed with MCB Camp Lejeune Environmental Conservation Branch.*
- *Construction activities would be concluded prior to sunset and would not occur on the beach without the supervision of a biologist (or other individual knowledgeable in sea turtle nesting) and coordination with the USFWS.*

- *Should it be necessary to leave equipment or materials on the beach overnight, these would be secured by placing sandbags around the potential obstacle. This would prevent the entanglement or entrapment of nesting sea turtles.*

- *Cable installation would occur at a depth greater than that of the average sea turtle nest cavity depth. Therefore, placement of the cable would not pose an entanglement hazard or obstruction to nest excavation.*

- *Following construction, the area would be smoothed of large ditches, holes, or other potential obstacles.*

- *All construction personnel would be advised that there are civil and criminal penalties for harming, harassing, or killing species protected under the ESA. A log would be maintained that details sightings of and/or injuries to sea turtles that occurred during the construction period.*

Adherence to these conservation measures currently in place would eliminate the potential for adverse effects on sea turtles.

Although 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; however, under such circumstances, consultation with the USFWS would be arranged before initiating any construction activities. The following mitigation measures would be taken (these measures are consistent with those presented in the biological opinion for Onslow Beach [USFWS, 2002]):

- *If nesting behavior or nests are identified, the area or nest is posted with signs prohibiting vehicular or human access.*

- *Prior to any 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 the proposed project site, the project is delayed until the breeding season is complete.*

Adherence to these conservation measures currently in place would eliminate the potential for adverse effects on piping plovers.

With respect to the federally threatened seabeach amaranth, a vegetation survey would be conducted to determine if the species occurs in the proposed construction area. If observed, the proposed construction area would be relocated to allow a minimum of a 3-m (10-ft) buffer area, thus avoiding impacts (USFWS, 2008b).

6.3.4 Site D

Minimal, if any, potential adverse landside environmental impacts would be anticipated at the Wallops Island landfall site. Thus, the only mitigation measures that would be required would be pre-construction surveys of the project area for any evidence of sea turtle or piping plover nesting activity.

6.4 Mitigation Related to Cable Installation at Sea

The following measures would be taken during cable installation to ensure that effects to marine resources, both biological and physical, are avoided to the maximum extent possible:

- Lookouts would be posted on all vessels participating in the cable installation processes, to observe for marine mammals and sea turtles. Lookouts would advise the Captain to the presence of a marine mammal or sea turtle, in order to prevent entanglement or ship strike.
- Lookouts would observe for *Sargassum* mats, and inform the Captain, to facilitate avoiding the mats to the maximum extent possible.
- If Site A is selected, cable installation would be suspended during the North Atlantic right whale calving season (from November 15 through April 15).
- A bottom mapping effort would be completed for Site A, the preferred alternative, prior to commencement of cable installation. This bottom mapping effort would utilize methodologies such as multi-beam sonar, photography and videography of bottom features, and biological and geological sampling. Information gained from this mapping effort would allow for the identification of important biological and physical features, such as biogenic reef formations and shipwrecks. Knowledge of the presence of these features would allow for their avoidance to the maximum extent practicable.

6.5 Dynamic Mitigation

The stated procedures, evaluations, and mitigation measures in this document are based on current conditions, regulations, and on the best science available at this time. The Navy understands that conditions, regulations, and knowledge will change over time. The Navy is dedicated to timely review of procedures and mitigation when new methods of minimizing environmental impact become evident. As current and future studies are completed, mitigation measures will evolve to ensure the greatest possible protection for both Navy interests, and the socioeconomic and natural environment.

The Navy also recognizes that additional mitigation may be required by regulatory agencies prior to construction and use of USWTR. The Navy will implement all feasible additional mitigation measures.

6.6 Alternative Protective Measures Considered but Eliminated

The vast majority of estimated sound exposures of marine mammals during proposed active sonar activities would not cause injury. Potential acoustic effects on marine mammals would be further reduced by the protective measures described above. Therefore, the Navy concludes that the proposed protective measures would achieve the least practical adverse impact on species or stocks of marine mammals.

A determination of "least practicable adverse impacts" includes consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity in consultation with the DoD. Therefore, the following additional mitigation measures were analyzed and eliminated from further consideration:

- Reduction of training.
    - The requirements for training have been developed through many years of iteration to ensure Sailors achieve levels of readiness to ensure they are prepared to properly respond to the many contingencies that may occur during an actual mission. These training requirements are designed to provide the experience needed to ensure Sailors are properly prepared for operational success.
    - There is no extra training built in to the plan, as this would not be an efficient use of the resources needed to support the training (e.g., fuel, time). Therefore, any reduction of training (including seasonal, weather- or light-based restrictions) would not allow Sailors to achieve satisfactory levels of readiness needed to accomplish their mission.

- Use of ramp-up to attempt to clear the range prior to the conduct of exercises.

  - Ramp-up procedures, (slowly increasing the sound in the water to necessary levels), are not a viable alternative for training exercises because the ramp-up would alert opponents to the presence of participants. This affects the realism of training in that the target submarine would be able to detect the searching unit prior to themselves being detected, enabling them to take evasive measures. This would insert a significant anomaly to the training, affecting its realism and effectiveness.

  - Though ramp-up procedures have been used in testing, the procedure is not effective in training Sailors to react to tactical situations, as it provides an unrealistic advantage by alerting the target. Using these procedures would not allow the Navy to conduct realistic training, or "train as they fight," thus adversely impacting the effectiveness of the military readiness activity.

- Visual monitoring using third-party observers from air or surface platforms, in addition to the existing Navy-trained lookouts.

  - The use of third-party observers would compromise security due to the requirement to provide advance notification of specific times/locations of Navy platforms.

  - Reliance on the availability of third-party personnel would also impact training flexibility, thus adversely affecting training effectiveness. The presence of other aircraft in the vicinity of naval exercises would raise safety concerns for both the commercial observers and naval aircraft.

  - Use of Navy observers is the most effective means to ensure quick and effective implementation of mitigation measures if marine species are spotted.

  - Navy personnel are extensively trained in spotting items on or near the water surface. Navy spotters receive more hours of training, and use their spotting skills more frequently, than many third-party trained personnel. Another critical skill set of effective Navy training is communication. Navy lookouts are trained to act swiftly and decisively to ensure that the appropriate actions are taken.

  - Crew members participating in training activities involving aerial assets have been specifically trained to detect objects in the water. The crew's ability to sight from both surface and aerial platforms provides excellent survey capabilities using the Navy's existing exercise assets.

development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the unceasing progress of the exercise and impact the effectiveness of the military readiness activity.

- Reducing or securing power during the following conditions.

  - Low-visibility/night training: The Navy must train in the same manner as it will fight. Reducing or securing power in low-visibility conditions would affect a commander's ability to develop this tactical picture as well as not provide the needed training realism. Training differently than what would be needed in an actual combat scenario would decrease training effectiveness and reduce the crew's abilities.

  - Strong surface duct: The Navy must train in the same manner as it will fight. As described above, the complexity of ASW requires the most realistic training possible for the effectiveness and safety of the Sailors. Reducing power in strong surface duct conditions would not provide this training realism because the unit would be operating differently than it would in a combat scenario, reducing training effectiveness and the crew's ability. Additionally, water conditions on USWTR may change rapidly, resulting in continually changing mitigation requirements, resulting in a focus on mitigation versus training.

- Vessel speed: Establish and implement a set vessel speed.

  - Navy personnel are required to use extreme caution and operate at a slow, safe speed consistent with mission and safety. Ships and submarines need to be able to react to changing tactical situations in training as they would in actual combat. Placing arbitrary speed restrictions would not allow them to properly react to these situations.

  - Training differently than what would be needed in an actual combat scenario would decrease training effectiveness and reduce the crew's abilities.

- Increasing power down and shut down zones.

  - The current power down zones of 457 and 914 m (1,500 and 3,000 ft), as well as the 183 m (600 ft) shut down zone were developed to minimize exposing marine mammals to sound levels that could cause TTS or permanent threshold shift (PTS), levels that are supported by the scientific community. Implementation of the shut down zones discussed above will prevent exposure to sound levels greater than 195 dB re 1µPa for animals sighted.

- The safety range the Navy has developed is also within a range Sailors can realistically maintain situational awareness and achieve visually during most conditions at sea.

- Requirements to implement procedures when marine mammals are present well beyond 914 m (1,000 yd) require that lookouts sight marine mammals at distances that, in reality, they cannot. These increased distances also greatly increase the area that must be monitored to implement these procedures. For instance, if a power down zone increases from 914 to 3,658 m (1,000 to 4,000 yd), the area that must be monitored increases sixteen fold.

• Adopt mitigation measures of foreign nation navies

  – Other nations' navies do not have the same critical requirement to train in ASW as does the Navy. For example, most other navies do not possess an integrated Strike Group and do not have an integrated ASW training requirement. Therefore, many of these navies employ mitigation during training as their measures do not impact their training requirements. In addition, the U.S. Navy is relied upon in combined battlegroups to conduct the integrated ASW that protects the entire battlegroup. That is why the Navy's ASW training is built around the integrated warfare concept and is based on the Navy's sensor capabilities, the threats faced, the operating environment, and the overall mission. Implementing other navies' mitigation would be incompatible with our requirements.

• Using active sonar with output levels as low as possible consistent with mission requirements and use of active sonar only when necessary.

  - Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, the sonar equipment power levels are always set consistent with mission requirements.

  - Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform's presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission.

- Reporting marine mammal sightings to augment scientific data collection.

  - Ships, submarines, aircraft, and personnel engaged in training events are intensively employed throughout the duration of the exercise. Their primary duty is accomplishment of the exercise goals, and they should not be burdened with additional duties unrelated to that task. Any additional workload assigned that is unrelated to their primary duty would adversely impact the effectiveness of the military readiness activity they are undertaking.

7 PUBLIC REVIEW PROCESS AND RESPONSE TO COMMENTS

Public involvement in the review of DEISs is stipulated in 40 CFR Part 1503 of the CEQ's regulations implementing NEPA and in 32 CFR Part 775 of the Navy's NEPA regulations. These regulations provide for active solicitation of public comment via the scoping process, public comment periods, and public meetings. This chapter has been prepared to document the public involvement process in the preparation of this final OEIS/EIS.

7.1 Public Review Process for October 2005 Draft OEIS/EIS

7.1.1 Scoping Process

The scoping process for the October 2005 draft OEIS/EIS was initiated by the publication of the NOI in the *Federal Register* on May 13, 1996. Scoping letters were also sent to members of Congress and federal, state, and local agencies, as well as members of the general public, notifying them of the beginning of the OEIS/EIS process. Several news articles concerning the project and the scoping process appeared in eastern North Carolina newspapers.

Fourteen letters were received from the following agencies, groups, and individuals:

- U.S. Department of the Army, Corps of Engineers, Norfolk District
- U.S. Department of the Army, Corps of Engineers, Wilmington District
- U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office
- U.S. Department of the Interior, Fish and Wildlife Service, Raleigh Field Office
- U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services
- North Carolina Department of Environment, Health and Natural Resources, Legislative and Intergovernmental Affairs
- North Carolina Department of Environment, Health and Natural Resources, Division of Parks and Recreation
- North Carolina Department of Environment, Health and Natural Resources, Division of Marine Fisheries
- Commonwealth of Virginia, Department of Environmental Quality
- Commonwealth of Virginia, Department of Historic Resources
- Hampton Roads Planning District Commission
- Mr. Ernie L. Burress
- Mr. John D. Costlow

Scoping comments fell into the following general major categories.

- Consideration of and National Pollutant Discharge Elimination System (NPDES), Section 10 (Rivers and Harbors Act), Section 404 (Clean Water Act), and other regulatory requirements in the EIS process.
- Potential for impacts to wetlands and impacts of cable landfall.
- Provision of detailed descriptions of the proposed USWTR facility; proposed training operations, schedules, and level of anticipated activity; and types of weapons and ordnance to be used, with appropriate supporting information.
- Alternatives analysis and discussion of the process for selecting the proposed alternative and eliminating others.
- Provision of oceanographic characteristics of potential project areas and oceanographic processes in the project areas that concentrate marine organisms or otherwise influence potential impacts.
- Impacts of construction and operation on: (1) the sea bottom; (2) aquatic resources in canyon areas along the continental shelf; (3) fishes, invertebrates, marine mammals, and their habitats and avoidance of those impacts; (4) state and federal threatened and endangered species; (5) commercial and recreational fisheries; and (6) reef habitat, among others.
- Types of signals (e.g., sonar, radar, laser, and microwave) to be used; frequency, duration, and intensity of acoustic signals; and acoustic impact on fish and on marine mammals.
- Impacts of other aspects of training operations (e.g., noise, concussions, vibration).
- Operational protocols to minimize adverse impacts to marine life.
- Collisions of vessels (military or civilian and military) on proposed ranges.
- Impacts on national [resource] reserves and the anticipated interaction between the USWTR and potential oil and gas lease blocks.

7.1.2 Filing and Distribution of the Draft

The formal NOI to prepare an OEIS/EIS was published in the *Federal Register* on May 13, 1996. In 2005, the range name was updated to the Undersea Warfare Training Range. USEPA filed a formal notice of availability (NOA) – *Notice of Public Hearings for a Draft Overseas Environmental Impact Statement/Environmental Impact Statement for the Undersea Warfare Training Range* – in the *Federal Register* on October 28, 2005, triggering the public review period for the draft OEIS/EIS. The document was distributed to officials of federal, state, and local governments, citizen groups and associations, and other interested parties. Further, the draft OEIS/EIS was made available to the public in the following locations:

Virginia Beach Central Library
4100 Virginia Beach Boulevard
Virginia Beach, VA 23452

Eastern Shore Public Library
23610 Front Street
Accomac, VA 23301

Chincoteague Island Library
4077 Main Street
Chincoteague Island, VA 23336

Carteret County Public Library
210 Turner Street
Beaufort, NC 28516

Onslow County Public Library
58 Doris Avenue East
Jacksonville, NC 28540

Jacksonville Public Library
Regency Square Branch
9900 Regency Boulevard
Jacksonville, FL 32225

A Web site was established for the project: http://projects.earthtech.com/USWTR/. An electronic copy of the draft OEIS/EIS was made available for public viewing on the website, and single copies of the document and executive summary were available from the Navy upon request.

7.1.3 Public Review Period and Public Hearings

Three combination informational meeting/hearings were held to inform members of the public of the results of the draft OEIS/EIS and to take comments, as follows:

Tuesday, November 15, 2005
Open house: 3:30 p.m. to 5:30 p.m., reopening at 6:30 p.m.
Hearing: 7:00 to 9:30 p.m.
Chincoteague Community Center
6155 Community Drive
Chincoteague, VA 23336

Thursday, November 17, 2005
Open house: 3:30 p.m. to 5:30 p.m., reopening at 6:30 p.m.
Hearing: 7:00 to 9:30 p.m.

Crystal Coast Civic Center
3505 Arendell Street
Morehead City, NC 28557

Monday, November 21, 2005
Open house: 3:30 p.m. to 5:30 p.m., reopening at 6:30 p.m.
Hearing: 7:00 to 9:30 p.m.
Wilson Center for the Arts
Florida Community College, Jacksonville South Campus
119091 Beach Boulevard
Jacksonville, FL 32246

Advertisements for the meetings appeared during the week and on Sunday in *The Virginia Pilot*, serving the Norfolk area; the *Daily Times,* Salisbury, Maryland; the *Eastern Shore News*, serving the Chincoteague area; the *Sun Journal*, New Bern, North Carolina; *Jacksonville Daily News*, Jacksonville, North Carolina; the *Carteret County News/Times*, Morehead City, North Carolina; and the *Florida Times Union*, Jacksonville, Florida. Figure 7-1 contains the notice that appeared in the North Carolina papers, as an example.

The meeting format combined open house information sessions and formal hearings. The open house portion that preceded the hearing consisted of a series of display stations, each of which dealt with a specific topic related to the project. Navy representatives staffed the stations and comment table. They provided information, answered questions, and took comments. Fact sheets were available that contained supporting information for each topic. Multiple means to provide comments during the open house were available to the public, including comment forms, tape recorders, and a laptop computer with personnel on hand to record dictated remarks. Court reporters recorded comments and statements offered during the hearings. Oral and written comments and comments received during the open house, at the hearing, and via mail or fax during the public comment period all became part of the official record and all carry the same weight.

Notice of Availability and Public Hearing on the
Draft Environmental Impact Statement (EIS) for the Undersea Warfare Training Range

The US Navy will host a public information session and a public hearing for the EIS that was prepared regarding the Navy's proposal to establish an undersea warfare training range (USWTR) offshore of the east coast of the United States. The USWTR would be a 500-square-nautical-mile (NM^2) area of the ocean instrumented with undersea cables and sensor nodes and used for anti-submarine warfare (ASW) training. Interested members of the public are urged to attend to learn about the project and the EIS, and to offer their comments. Written comments will be taken at both the public information session and at the hearing. Oral comments can be made at the hearing and will be limited to three (3) minutes per speaker.

November 17, 2005 Crystal Coast Civic Center
3505 Arendell Street
Morehead City, NC 28557

The public information session will be from 3:30 p.m. to 5:30 p.m. and will open again at 6:30 p.m. The public hearing will be held from 7:00 p.m. to 9:30 p.m.

The environmental impact statement is available to the public on the Internet at http://projects.earthtech.com/USWTR/ and at the following locations:

Carteret County Public Library 210 Turner Street Beaufort, NC 28516	Onslow County Public Library 58 Doris Avenue East Jacksonville, NC 28540

Figure 7-1

2005 Public Scoping Meeting Advertisement

The original public review period was from the date of publication of the NOI, October 28, 2005, to December 28, 2006; however, in response to requests for an extension and to comments to that effect, the Navy extended the public comment period to January 30, 2006, providing a full 90 days for comments.

Comments received during the public comment period were posted on the project Web site and addressed via revised text in affected sections of the revised draft OEIS/EIS. Comments fell into the following major categories:

- Acoustic modeling process and results, including biological assumptions, consideration of the impacts of reverberation, sonar characteristics, and Level A and B harassment thresholds, among others
- Assessment of fish and marine mammal population/distribution
- Sonar impacts on fish, marine mammals, sea turtles, and birds

- Specific impacts on North Atlantic right whales
- Marine mammal strandings and ship strikes
- Socioeconomic impacts, including potential impacts on commercial and recreational fishing, diving, etc.
- Landside impacts
- Impacts on marine habitat, including marine life and marine protected areas
- Impacts to cultural resources
- Impacts of sonar on divers
- Cumulative impacts
- Solid and hazardous waste issues, including debris, entanglement, and toxicity
- Mitigation measures
- NEPA compliance and discussion of the proposed action
- Other regulatory compliance (e.g., MMPA, ESA, etc.)

As a result of comments received after publication of the draft OEIS/EIS in 2005, it was determined to add Charleston, South Carolina to the analysis of alternative sites for the USWTR. Addition of the new alternative site, availability of new data since the 2005 documents were published, and some modification of the methodology used to analyze behavioral impacts on marine mammals led to the Navy's decision to issue a revised draft OEIS/EIS.

7.2 Public Review Process for 2008 Revised Draft OEIS/EIS

7.2.1 Scoping Process

The Navy published its NOI to prepare the revised OEIS/EIS and to open another scoping comment period in the *Federal Register* on September 21, 2007. The revised draft OEIS/EIS was released to the public on September 12, 2008.

Starting the day the NOI was published, the Navy placed advertisements (Figure 7-2) which announced its intent to issue a revised draft OEIS/EIS in 22 newspapers from Virginia to Florida, running three consecutive days in daily papers, two consecutive weeks in weekly papers, and three publication dates in papers that publish three times a week. These newspapers were:

- *Salisbury Daily Times* in Maryland;
- *Salisbury News* in Delaware;
- *Virginian-Pilot*, *Chincoteague Beacon*, and *Accomack Eastern Shore News* in Virginia;
- *Star News*, *Jacksonville Daily News*, *Carteret County News*, *Tideland News*, and *Havelock News* in North Carolina;
- *Post & Courier*, *Myrtle Beach Times*, *Myrtle Beach Herald Star*, *Walterboro Press & Standard*, and *Coastal Observer* in South Carolina;
- *Savannah Morning News*, *Brunswick News*, *Savannah Tribune*, and *Darien News* in Georgia; and
- *Florida Times-Union*, *Beaches Leader*, *and St. Augustine Record* in Florida.

Public input is helping Navy revise the Draft Overseas Environmental Impact Statement (OEIS)/ Environmental Impact Statement (EIS), Undersea Warfare Training Range

The Navy announces its intent to revise the previously released Draft OEIS/EIS assessing potential environmental impacts of establishing an undersea warfare training range (USWTR) off the eastern coast of the United States for anti-submarine warfare (ASW) training. Based on comments received from federal agencies, state agencies, and members of the public, the Navy determined that a new DOEIS/EIS should be prepared, incorporating suggestions received during the public review and comment period. The changes contemplated involve addition of an alternative and modification of the methodology used to analyze behavioral impacts on marine mammals.

Recognizing the continued importance of public input, the Navy is also reopening the scoping process and invites you to submit any comments relevant to the scope of issues to be addressed in the revised DOEIS/EIS. Scoping comments previously submitted following publication of the 1996 NOI are still valid and will be considered. All comments received during the October 2005 DOEIS/EIS public review and comment period will also be considered during this scoping process and should not be resubmitted. Please submit any new comments by October 22, 2007, to ensure consideration.

Mail comments to:
USWTR DOEIS/EIS Project Manager, Naval Facilities Engineering Command Atlantic
6506 Hampton Boulevard, Norfolk, Virginia 23508-1278
facsimile (757) 322-4894

Additional background information on the USWTR, including the prior DOEIS/EIS and the public comments received, are available via the website http://projects.earthtech.com/USWTR/

Figure 7-2

2007 Revised Draft OEIS/EIS and Scoping Advertisement

These advertisements also announced another opportunity for the public to be heard: an additional public scoping period beginning with the publication of the NOI and ending on

October 22, 2007. The advertisements urged agencies, organizations, and members of the general public to submit comments not previously submitted for the Navy to use in developing the scope of the revised document. There were no public meetings or hearings during this time. Also, concurrent with publication of the NOI to produce the revised draft OEIS/EIS, a one-page newsletter that contained background on the project and reflected the intent to revise the document was sent to the entire project mailing list. This mailing list included all parties that had provided contact information at the November 2005 public meetings as well as local, regional, and federal officials and all organizations that had previously expressed interest.

Twenty letters were received from the following agencies, groups, and individuals:

- U.S. Dept. of Interior - Fish and Wildlife Service
- U.S. Dept. of Interior - Minerals Management Service
- North Carolina Dept. of Administration
- North Carolina Dept. of Environment and Natural Resources – Div. of Coastal Management
- North Carolina Wildlife Resources Commission
- South Carolina Dept. of Natural Resources
- National Resources Defense Council
- Seabird Pelagic Trips
- Southern Environmental Law Center
- Linn Barrett
- J. Capozelli
- Lexie Cataldo
- Sandra Davidson
- Kelly Farr
- Dwight Hines
- Janice Orion
- P. J. Pillmore
- Genevieve Rigsby
- Tina Seastrom
- State of Maryland Military Department

In addition, more than 12,000 form letters were received by fax after the close of the comment period.

Comments from that scoping process were considered in the preparation of the revised draft OEIS/EIS. The comments provided in these letters fall into some of the same general categories as did the comments received after publication of the October 2005 draft OEIS/EIS, most particularly pertaining to the following areas of interest:

- Impacts on marine mammals, sea turtles, fish, seabirds, and marine habitat (including concern about threatened and endangered species)

- Alternatives analysis and incorporation of seasonal variations in activities into alternatives analysis
- Specific concerns about the North Atlantic right whale
- Impacts on cultural resources
- NEPA compliance
- Mitigation measures
- Statements by prior commentors to the effect that issues raised previously are still open concerns.

7.2.2 Filing and Distribution of the 2008 Draft OEIS/EIS

Preparation of the draft OEIS/EIS followed the receipt of the scoping comments. Publication of the notice of availability in the *Federal Register* was made on September 12, 2008 starting a 45-day comment period. The document was distributed to officials of federal, state, and local governments, citizen groups and associations, and other interested parties (see Appendix I). The notice of availability announced public meeting/hearings would be held in Chincoteague, Virginia (September 29); Morehead City, North Carolina (October 1); North Charleston, South Carolina (October 6); and Jacksonville, Florida (October 7). The draft OEIS/EIS was made available to the public in the following locations:

Worcester County Library
Ocean City Branch
10003 Coastal Highway
Ocean City, MD 21842

Wicomico County Free Library
122 South Division Street
Salisbury, MD 21801

Virginia Beach Central Library
4100 Virginia Beach Boulevard
Virginia Beach, VA 23452

Eastern Shore Public Library
23610 Front Street
Accomac, VA 23301

Chincoteague Island Library
4077 Main Street
Chincoteague Island, VA 23336

Carteret County Public Library
210 Turner Street
Beaufort, NC 28516

Onslow County Public Library
58 Doris Avenue East
Jacksonville, NC 28540

Charleston County Public Library
68 Calhoun Street
Charleston, SC 29401

Jacksonville Public Library
Regency Square Branch
9900 Regency Boulevard
Jacksonville, FL 32225

7.2.3 Public Review Period and Public Hearings

Four combination informational meeting/hearings were held to inform members of the public of the results of the draft OEIS/EIS and to take comments, as follows:

Monday, September 29, 2008
Chincoteague Community Center
6155 Community Drive
Chincoteague, VA 23336

Wednesday, October 1, 2008
Crystal Coast Civic Center
3505 Arendell Street
Morehead City, NC 28557

Monday, October 6, 2008
The Sheraton North Charleston
4770 Goer Drive
North Charleston, SC 29406

Tuesday, October 7, 2008
University of North Florida
University Center
12000 Alumni Drive
Jacksonville, FL 32224

Advertisements for the meetings (Figure 7-3) appeared in:

- *The Virginian Pilot* in Norfolk, Virginia;
- *Eastern Shore News* and *Chincoteague Beacon* in Chincoteague, Virginia;
- *Daily Times* in Salisbury, Maryland;
- *Eastern Shore Banner* in Cambridge, Maryland;
- *Ocean City Today* in Ocean City, Maryland;
- *Sun Journal* in New Bern, North Carolina;
- *Jacksonville Daily News* in Jacksonville, North Carolina;
- *Havelock News* in Havelock, North Carolina;
- *Star News* in Wilmington, North Carolina;
- *Tideland News* in Swansboro, North Carolina;
- *Carteret County News/Times* in Morehead City, North Carolina;
- *The Charleston Daily Mail* in Charleston, South Carolina;
- *The Post & Courier* in Charleston, South Carolina;
- *The Coastal Observer* in Pawley Island, South Carolina;
- *Goose Creek Gazette* in Goose Creek, South Carolina;
- *Herald Star* and *Times Newspapers* in Myrtle Beach, South Carolina;
- *Walterboro Press & Standard* in Walterboro, South Carolina;
- *Brunswick News* in Brunswick, Georgia;
- *Savannah Morning News* in Savannah, Georgia;
- *Savannah Tribune* in Savannah, Georgia;
- *Darien News* in Darien, Georgia;
- *St. Augustine Record* in St. Augustine, Florida;
- *Jacksonville Beach Sun-Times* in Jacksonville Beach, Florida; and,
- *Florida Times Union* in Jacksonville, Florida.

Notice of Availability and Public Hearing on the
Draft Overseas Environmental Impact Statement (OEIS)/Environmental Impact Statement (EIS) for the Undersea Warfare Training Range

The US Navy will host a public information session and a public hearing for the EIS that was prepared regarding the Navy's proposal to establish an Undersea Warfare Training Range (USWTR) offshore of the east coast of the United States. The USWTR would be a 500-square-nautical-mile (NM^2) area of the ocean instrumented with undersea cables and sensor nodes and used for anti-submarine warfare (ASW) training. Interested members of the public are urged to attend to learn about the project and the EIS, and to offer their comments. Written comments will be taken at both the public information session and at the hearing. Oral comments can be made at the hearing and will be limited to three (3) minutes per speaker.

September 29, 2008 The Chincoteague Center
6155 Community Drive
Chincoteague, VA 23336

The public information session will be from 4:00 p.m. to 7:00 p.m. The public hearing will be held from 7:00 p.m. to 9:00 p.m.

The environmental impact statement is available to the public on the Internet at http://projects.earthtech.com/USWTR/ and at the following locations:

Chincoteague Island Library
4077 Main Street
Chincoteague Island, VA 23336

Virginia Beach Central Library
4100 Virginia Beach Boulevard
Virginia Beach, VA 23452

Wicomico County Free Library
122 South Division Street
Salisbury, MD 21801

Eastern Shore Public Library
23610 Front Street
Accomac, VA 23301

Worcester County Library
Ocean City Branch
10003 Postal Highway
Ocean City, MD 21842

Figure 7-3

Sample Advertisement for NOA and Public Hearings on the 2008 Draft OEIS/EIS

The meeting format was a combination of open house information sessions and formal hearings. The open house portion that preceded the hearing consisted of a series of display stations, each of which dealt with a specific topic related to the project. Navy representatives staffed the stations and comment table. They provided information, answered questions, and took comments. Fact sheets were available that contained supporting information for each topic. Multiple means to provide comments during the open house were available to the public, including comment forms, tape recorders, and a laptop computer with personnel on hand to record dictated remarks. Court reporters recorded comments and statements offered during the hearings. Oral and written comments and comments received: during the open house; at the hearing; via mail; by computer to the USWTR Web site; or fax during the public comment period all became part of the official record and were considered in the preparation of the final OEIS/EIS.

Comments received during the public comment period were addressed via revised text in affected sections of the final OEIS/EIS. Comments fell into the following major categories:

- Acoustic modeling process and results, including biological assumptions, consideration of the impacts of reverberation, sonar characteristics, and Level A and B harassment thresholds, among others;
- Assessment of fish, sea turtle, seabird, and marine mammal population/distribution;
- Sonar impacts on fish, sea turtles, seabirds, and marine mammals;
- Impacts on North Atlantic right whales;
- Marine mammal strandings and ship strikes;
- Socioeconomic impacts, including potential impacts on commercial and recreational fishing, diving, etc.;
- Landside impacts;
- Impacts on marine habitat, including marine life and marine protected areas;
- Impacts to cultural resources;
- Cumulative impacts;
- Solid and hazardous waste issues, including debris, entanglement, and toxicity;
- Mitigation measures;
- NEPA compliance and discussion of the proposed action; and,
- Other regulatory compliance (e.g., MMPA, ESA, etc.).

The letters and hearing presentations have been numbered based upon the affiliation of the author/speaker (e.g., federal agency, state agency, member of the public, etc.) and the associated comments have been coded to identify the location of a comment. Appendix H of this final OEIS/EIS provides a matrix of the comments submitted; it is organized based upon the category of the comment. A CD-ROM, placed in the inside cover of this final OEIS/EIS, provides electronic copies of both the coded and uncoded comment letters, as well as the transcripts of the public hearings. The Record of Decision for the USWTR is scheduled to be released in the summer of 2009.

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9 GLOSSARY

Acoustics: The scientific study of sound, especially of its generation, transmission, and reception.

Acoustically mediated bubble growth: A suggested cause of injury to marine mammals related to gas accumulation in the bloodstream. Under the **acoustically mediated bubble growth** hypothesis, stable gas bubbles could be destabilized by high-level sound exposures such that bubble growth occurs through static diffusion of gas out of the tissues. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness (see related concept of "rectified diffusion").

Ambient noise: The typical or persistent environmental background noise present in the ocean.

Anthropogenic noise: Noise related to, or produced by, human activities.

Antisubmarine warfare (ASW): Naval operations conducted against submarines, their supporting forces, and operating bases.

Asymmetry: Asymmetry/asymmetric has many definitions and is used to describe many things, from weapons systems and tactics, through strategy and worldviews, to comprehension of what is sanctioned by morality or international law. **Asymmetric threats** are commonly viewed as having the potential to produce widespread civilian casualties or considerable environmental damage.

Attenuation: A decrease in level over time or space or distance.

Baleen: The filtering plates that hang from the upper jaw of a baleen whale.

Bathymetry: The measurement of water depth at various places in a body of water; the information derived from such measurements.

Benthic: Referring to the bottom-dwelling community of organisms that creep, crawl, burrow, or attach themselves to either the sea bottom or such structures as ships, buoys, and wharf pilings (e.g., crabs, clams, worms, etc.).

Bight: A long, gradual bend or recess in the coastline that forms a large, open bay.

Biologically important activities/behaviors: Those activities or behaviors essential to the continued existence of a species, such as migration, breeding/calving, or feeding.

Brumate: A specific term for when reptiles "hibernate" or go into a dormant state by burying themselves in sand or sediment during cold periods or during cold winters.

Cetacean: Of or belonging to the order Cetacea, which includes aquatic mammals with anterior flippers, no posterior limbs, and a dorsal fin, such as whales, dolphins, and porpoises.

Continental shelf: A shallow submarine plain of varying width forming a border to a continent and typically ending in a steep slope to the oceanic abyss.

Decibel (dB): A unit used to express the relative difference in power, usually between acoustic or electrical signals, equal to ten times the common logarithm of the ratio of the two levels.

Decompression sickness: a condition caused by release of gas bubbles in tissue upon rapid ascent from a compressed atmosphere and resulting exposure to rapidly lowered air pressure

Demersal: Living at or near the bottom of a waterbody, but having the capacity for active swimming.

Endangered species: Defined in 16 USC 1532 as any species that is in danger of extinction throughout all or a significant portion of its range. Federally endangered species are listed in 50 CFR 17.11 and 17.12.

Energy flux density level (EL): A measure of the sound energy flow per unit area expressed in decibels. EL is stated in dB re 1 μPa^2-s for underwater sound and dB re $(20\ \mu Pa)^2$-s for airborne sound.

Epifauna: Organisms living on the surface of the sediment/sea bed.

Essential fish habitat (EFH): Those waters and substrate that are defined within Fishery Management Plans for federally-managed fish species as necessary to fish for spawning, breeding, feeding, or growth to maturity.

Fishing hotspot: An area of concentrated fishing.

Frequency: Description of the rate of disturbance, or vibration, measured in cycles per second. Cycles per second are usually referred to as the unit of measure of Hertz (Hz). In acoustics, frequency is characterized in general terms as low, mid, or high. The Navy categorizes these as follows:

- **Low frequency (LF)** sound is below 1,000 Hz.
- **Mid frequency (MF)** sound is between 1 and 10 kHz (kilohertz).
- **High frequency (HF)** sound is above 10 kHz.

Harassment: Intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering.

Harassment zones: The volumes of ocean in which Level A or B harassment (defined below) are predicted to occur.

- **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.

- **Level B harassment zone:** Begins just beyond the point of slightest injury and extends outward from that point. It includes all animals that may potentially experience Level B harassment. Physiological effects extend beyond the range of slightest injury to a point where slight temporary distortion of the most sensitive tissue occurs, but without destruction or loss of that tissue. The animals predicted to be in this zone experience Level B harassment by virtue of temporary impairment of sensory function (altered physiological function) that can disrupt behavior.

Hydrography: The characteristic features (e.g., flow, depth) of bodies of water.

Infauna: Animals living within the sediment.

Irreversible and irretrievable resources: Those resources that are consumed during the construction and implementation of a project and that cannot be reused. Because their reuse is impossible, they are considered irreversibly and irretrievably committed to the development of the proposed project. These resources would include expendable materials necessary for construction, as well as fuels and other forms of energy that are utilized during project implementation.

Isobath: A line on a chart or map connecting points of equal depths; bathymetric contour.

Letter of authorization (LOA): The Marine Mammal Protection Act provides for a “small take authorization” (i.e., letter of authorization) for maritime activities, provided the National Marine Fisheries Service finds that the takings would be of small numbers (i.e., taking would have a negligible impact on that species or stock), would have no more than a negligible impact on those marine mammal species not listed as depleted, and would not have an unmitigable adverse impact on subsistence harvests of these species.

Level A harassment: 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** is identified as the destruction or loss of biological tissue. The destruction or loss of biological tissue will result in an alteration of physiological function that exceeds the normal daily physiological variation of the intact tissue.

Level B harassment: 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. Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects have the potential to cause Level B harassment.

Live/hard bottom habitat: Scattered irregularly over the continental shelf, live/hard bottom habitat is comprised of zones of highly concentrated invertebrate and algal growth, in association with marked deviations in topographical relief, that support substantial fish assemblages. Live/hard bottom habitat is considered essential fish habitat.

Masking: The obscuring of sounds of interest by interfering sounds, generally at similar frequencies.

Mysticete: Any of several whales of the suborder Mysticeti having symmetrical skulls, paired blowholes, and plates of whalebone (baleen plates) instead of teeth. Mysticetes are filter-feeding whales, also referred to as baleen whales.

Notice of intent (NOI): A written notice published in the *Federal Register* that announces the intent to prepare an EIS. Also provides information about a proposed federal action, alternatives, the scoping process, and points of contact within the lead federal agency regarding the EIS.

Odontocete: Any of the toothed whales (without baleen plates) of the suborder Odontoceti having a single blowhole and asymmetrical skull, such as orcas, dolphins, and porpoises.

Onset permanent threshold shift (PTS): PTS (defined below) 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 Marine Mammal Protection Act. 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.

Onset temporary threshold shift (TTS): TTS (defined below) is recoverable and 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 physiological effects. This follows from the concept that hearing loss potentially affects an animal’s ability to react normally to the sounds around it. Therefore, the potential for TTS qualifies as a Level B harassment that is mediated by physiological effects upon the auditory system.

Pelagic: Living in the water column. Plants and animals that are free-floating and drift passively, or animals that are strong swimmers.

Permanent threshold shift (PTS): Very high sound levels may rupture the eardrum or damage the small bones in the middle ear. Lower-level exposures may cause permanent or temporary hearing loss, which is called a noise-induced threshold shift, or simply a **threshold shift (TS)**. A TS may be permanent, called a **permanent threshold shift (PTS)**, or temporary, called a **temporary threshold shift (TTS)**.

Physiological effect: Defined in the OEIS/EIS as a variation in an animal's physiology that results from an anthropogenic acoustic exposure and exceeds the normal daily variation in physiological function.

Pinniped: Any of a suborder (Pinnipedia) of aquatic carnivorous mammals such as a seal or walrus with all four limbs modified into flippers.

Received level (RL): The level of sound that arrives at the receiver, or listening device (hydrophone). The received level is the source level minus the transmission losses from the sound traveling through the water.

Record of decision (ROD): In regard to an EIS, the notice published in the *Federal Register* that contains the lead agency's decision, and identifies both the alternatives and the mitigation measures to be used.

Rectified diffusion: A potential cause of injury to marine mammals related to gas bubble accumulation in the bloodstream. **Rectified diffusion** is the process of increasing the size of a gas bubble by exposing it to a sound field. Repetitive diving by marine mammals can cause the blood and other tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure. 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 (see related "**acoustically mediated bubble growth**").

Resonance: A suggested cause of injury in marine mammals is air cavity resonance due to sonar exposure. **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).

***Sargassum* habitat:** Pelagic brown algae *Sargassum natans* and *S. fluitans* form a dynamic structural habitat within the warm waters of the western North Atlantic. Pelagic *Sargassum* is considered essential fish habitat because it provides protection, feeding opportunity, and is used as a spawning substrate to a variety of fish species.

Scoping: Early consultation with federal and state agencies and interested parties to identify possible alternatives and the significant issues to be addressed in the EIS.

Sirenian: Any of an order (Sirenia) of aquatic herbivorous mammals including the manatee, dugong, and Steller's sea cow.

Sonar: An acronym for SOund NAvigation and Ranging. It includes any system that uses underwater sound, or acoustics, for observations and communications. There are two broad types of sonar:

- **Passive sonar** detects the sound created by an object (source) in the water. This is a one-way transmission of sound waves traveling through the water from the source to the receiver.

- **Active sonar** detects objects by creating a sound pulse, or ping, that transmits through the water and reflects off the target, returning in the form of an echo. This is a two-way transmission (source to reflector to receiver).

Sound exposure level (SEL): The total acoustic energy of a noise, it is calculated as the summation of energy over time.

Sound pressure level (SPL): A measure of the root-mean square, or "effective," sound pressure in decibels. SPL is expressed in dB re 1 µPa for underwater sound and dB re 20 µPa for airborne sound.

Source level (SL): The sound transmitted into the water by a sound source, such as an active sonar ping.

Spatial: Pertaining to space, or pertaining to distance such as spatial variation (variation over distance).

Submarine acoustic signature: The sound a submarine generates under water.

Substrate: The base on which an organism lives.

SURTASS LFA sonar: Long-range, all-weather low frequency sonar system composed of both active and passive components. SURTASS (Surveillance Towed Array Sensor System) is the passive component. LFA (Low Frequency Active) is the active component.

Temporal: Of or relating to time.

Temporary threshold shift (TTS): Very high sound levels may rupture the eardrum or damage the small bones in the middle ear. Lower-level exposures may cause permanent or temporary hearing loss, which is called a noise-induced threshold shift, or simply a **threshold shift (TS)**. A TS may be permanent, called a **permanent threshold shift (PTS)**, or temporary, called a **temporary threshold shift (TTS)**.

Threatened species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened species are listed in 50 CFR 17.12.

Transmission loss (TL): Energy losses that occur as the pressure wave, or sound, travels through the water. The associated wavefront diminishes due to the spreading of the sound over an increasingly larger volume and the absorption of some of the energy by seawater.

Uncontrolled Airspace: Airspace of defined dimensions in which no air traffic control services to either instrument flight rules or visual flight rules aircraft will be provided, other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

U.S. Territorial Waters: Sea areas within 12 nautical miles of the U.S. continental and island shoreline.

Volatile Organic Compound (VOC): One of a group of chemicals that react in the atmosphere with nitrogen oxides in the presence of heat and sunlight to form ozone; it does not include methane and other compounds determined by the U.S. Environmental Protection Agency to have negligible photochemical reactivity. Examples of volatile organic compounds include gasoline fumes and oil-based paints.

Warning Area: A designated airspace in which flights are not restricted but avoidance is advised during published times of use.

Wetlands: Lands or areas that either contain much soil moisture or are inundated by surface or groundwater with a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include such areas as bogs, marshes, mud and tidal flats, sloughs, river overflows, seeps, springs, or swamps.

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