Atlantic Fleet Training and Testing Final Environmental Impact Statement/ Overseas Environmental Impact Statement

Volume IV

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NAVSEA NAVAL SEA SYSTEMS COMMAND

NAVY

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APPENDIX A
Navy Activity Descriptions

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Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

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A. NAVY ACTIVITY DESCRIPTIONS

The Navy has been conducting military readiness activities throughout the northwestern Atlantic Ocean, Gulf of Mexico, and inshore waters for decades. The tempo and types of training and testing activities have fluctuated within the Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area) due to changing requirements, the introduction of new technologies, the dynamic nature of international events, advances in warfighting doctrine and procedures, and force structure changes. Such developments have influenced the frequency, duration, intensity, and location of required training and testing.

A.1 Description of Sonar, Munitions, Targets, and Other Systems Employed in Atlantic Fleet Training and Testing Events

The Navy uses a variety of sensors, platforms, weapons, and other devices, including ones used to ensure the safety of Sailors and Marines, to meet its mission. Training and testing with these systems may have the potential to introduce acoustic (sound) energy and expended materials into the environment. The environmental impact of these activities was analyzed in Chapter 3 (Affected Environment and Environmental Consequences) of this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS). This appendix presents and organizes sonar systems, munitions, targets, and other systems in a manner intended to facilitate understanding of both the activities that use them and the analysis of their environmental effects, described in Chapter 3 (Affected Environment and Environmental Consequences) of this EIS/OEIS.

A.1.1 Sonar Systems and Other Acoustic Sources

Sonar. Sonar, originally an acronym for “Sound Navigation And Ranging,” is a technique that uses underwater sound to navigate, communicate, or detect underwater objects (the term sonar is also used for the equipment used to generate and receive sound). There are two basic types of sonar: active and passive.

Active sonar emits sound waves that travel through the water, reflect off objects, and return to a receiver. Sonar is used to determine the distance to an underwater object by calculating the speed of sound in water and the time for the sound wave to travel to the object and back. For example, active sonar systems are used to track targets or to aid in vessel navigation by identifying known ocean floor features. Some whales, dolphins, and bats use echolocation, a similar technique, to identify their surroundings and to locate prey.

Passive sonar uses listening equipment, such as underwater microphones (hydrophones) and receiving sensors on ships, submarines, aircraft, or autonomous vehicles, to pick up underwater sounds. The advantage of passive sonar is that it places no sound in the water and, thus, does not reveal the location of the listening vessel. Passive sonar can indicate the presence, character, and direction of noise producing objects such as ships and submarines; however, passive sonar is increasingly ineffective as modern submarines become quieter. Passive sonar has no potential acoustic impact on the environment and, therefore, is not discussed further or analyzed within this EIS/OEIS.

All sounds, including sonar, are categorized by frequency. For this EIS/OEIS, active sonar is categorized into four frequency ranges: low-frequency,[1] mid-frequency, high-frequency, and very high-frequency.

- Low-frequency active sonar emits sounds at frequencies less than 1 kilohertz (kHz). Low-frequency active sonar is useful for detecting objects at great distances because low-frequency sounds do not dissipate as rapidly as higher-frequency sounds.
- Mid-frequency active sonar emits sounds at frequencies from 1 to 10 kHz. Mid-frequency active sonar is the Navy's primary tool for detecting and identifying submarines. Active sonar in this frequency range provides a valuable combination of range and target accuracy.
- High-frequency active sonar emits sounds at frequencies greater than 10 kHz, up to 100 kHz. High-frequency sounds dissipate rapidly and have a small effective range; however, high-frequency sounds provide higher resolution of objects and are useful at detecting and identifying smaller objects such as sea mines.
- Very high-frequency sources are those that operate above 100 kHz but below 200 kHz. Very high-frequency sounds provide even higher resolution of objects and are sometimes used for underwater communication.

Modern sonar technology includes a variety of sonar sensor and processing systems. In concept, the simplest active sonar emits sound waves, or "pings," sent out in multiple directions, and the sound waves then reflect off of the target object in multiple directions (Figure A.1-1).

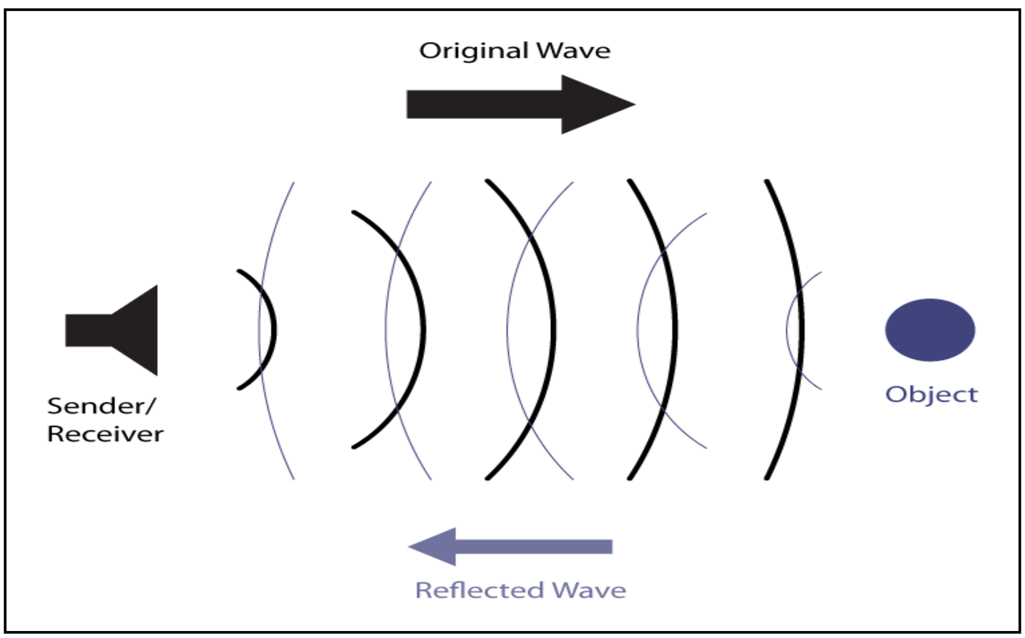


Figure A.1-1: Principle of an Active Sonar

[1] Surveillance Towed Array Sensor System (SURTASS) Low-Frequency Active sonar, which may be used in the Study Area, is not among the sources analyzed in this document. The potential environmental impacts from use of SURTASS Low-Frequency Active sonar are analyzed in separate analyses under the National Environmental Policy Act.

The sonar source calculates the time it takes for reflected sound waves to return; this calculation determines the distance to the target object. More sophisticated active sonars emit a ping and then rapidly scan or listen to the sound waves in a specific area. This provides both distance to the target and directional information. Even more advanced sonars use multiple receivers to listen to echoes from several directions simultaneously and provide efficient detection of both direction and distance. It should be noted that active sonar is rarely used continuously throughout the listed activities. In addition, when sonar is in use, the sonar "pings" occur at intervals, referred to as a duty cycle, and the signals themselves are very short in duration. For example, a sonar that emits a 1-second ping every 10 seconds has a 10 percent duty cycle.

The Navy utilizes sonar systems and other acoustic sensors in support of a variety of mission requirements. Primary uses include detection of and defense against submarines (anti-submarine warfare) and mines (mine warfare), safe navigation and effective communications, and oceanographic surveys. Specific examples of how sonar systems are used for Navy activities are discussed in the following sections.

Anti-Submarine Warfare. Systems used in anti-submarine warfare include sonars, torpedoes, and acoustic countermeasure devices. These systems are employed from a variety of platforms (surface ships, submarines, helicopters, and fixed-wing aircraft). Surface ships conducting anti-submarine warfare are typically equipped with hull-mounted sonar (passive and active) for the detection of submarines (or submarine targets during training and testing events). Helicopters use dipping sonar or sonobuoys (passive and active) to locate submarines (or targets). Fixed-wing aircraft deploy both active and passive expendable sonobuoys to assist in detecting and tracking submarines (or targets). Submarines are equipped with hull-mounted sonars to detect, localize, and track other submarines and surface ships. Submarines primarily use passive sonar; active sonar is used mostly for navigation. There are also unmanned vehicles currently being developed to deploy anti-submarine warfare systems.

Anti-submarine warfare activities often use mid-frequency (1 to 10 kHz) active sonar, though low-frequency and high-frequency active sonar systems are also used for specialized purposes. The Navy is currently developing and testing sonar systems that may utilize lower frequencies and longer duty cycles—albeit at lower source levels—than current systems. However, these new systems would only be operational if they significantly increase the Navy's ability to detect and identify quiet submarine threats.

Typical active sonar systems and acoustic sensors used during anti-submarine warfare sonar training and testing exercises include the following:

- **Surface Ship Sonar Systems:** A variety of surface ships operate hull-mounted or tethered mid-frequency active sonar during training exercises and testing activities (Figure A.1-2). Only cruisers and destroyers have surface ship sonar systems. The littoral combat ship and new frigate will have a tethered variable depth sonar system. Unmanned surface vessels can also include sonar systems, such as the variable depth sonar and mine hunting sonar.

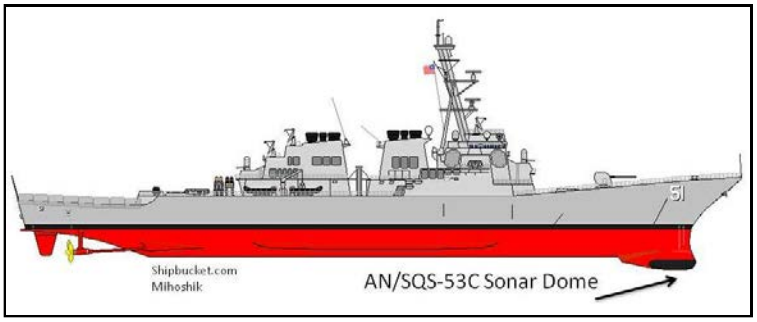


Figure A.1-2: Guided Missile Destroyer with an AN/SQS-53 Sonar

- **Submarine Sonar Systems:** Submarines are equipped with hull-mounted mid-frequency and high-frequency active sonar (Figure A.1-3) used to detect and target enemy submarines and surface ships. A submarine's mission relies on its stealth; therefore, a submarine uses its active sonar sparingly because each sound emission gives away the submarine's location.

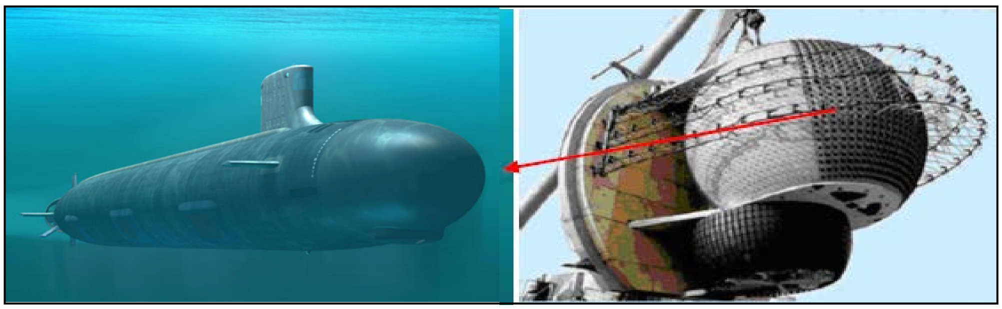


Figure A.1-3: Submarine AN/BQQ-10 Active Sonar Array

- **Aircraft Sonar Systems:** Aircraft sonar systems include sonobuoys and dipping sonars.
  - **Sonobuoys:** Active sonobuoys are expendable devices that contain a data transmitter and a hydrophone. The sounds collected by the sonobuoy are transmitted back to the operator (aboard ship or aircraft) for analysis. Sonobuoys are either active or passive and allow for short- and long-range detection of surface ships and submarines. These systems are deployed by ship, helicopter, and fixed-wing patrol aircraft (Figure A.1-4).

Figure A.1-4: Sonobuoy (e.g., AN/SSQ-62)

- **Dipping Sonars:** Dipping sonars are recoverable devices lowered into the water via cable from manned and unmanned helicopters (Figure A.1-5). The sonar detects underwater targets and determines the distance and movement of the target relative to the position of the helicopter.

Figure A.1-5: Helicopter Deploys Dipping Sonar

- **Exercise Torpedoes:** Some torpedoes used in training and testing activities may transmit active sonar signals. Surface ships, aircraft, and submarines primarily use torpedoes in anti-submarine warfare (Figure A.1-6). Recoverable, non-explosive torpedoes, categorized as either lightweight or heavyweight, are used during training and testing. Torpedoes operate autonomously, or in the case of heavyweight torpedoes, use a guidance system to operate the torpedo remotely through an attached wire (guidance wire). The autonomous guidance systems operate either passively (listening for sounds generated by the target) or actively (pinging to search for the target). Torpedo training in the Study Area is mostly simulated—solid masses that approximate the weight and shape of a torpedo are fired rather than fully functional torpedoes. Testing in the Study Area mostly uses fully functional exercise torpedoes.

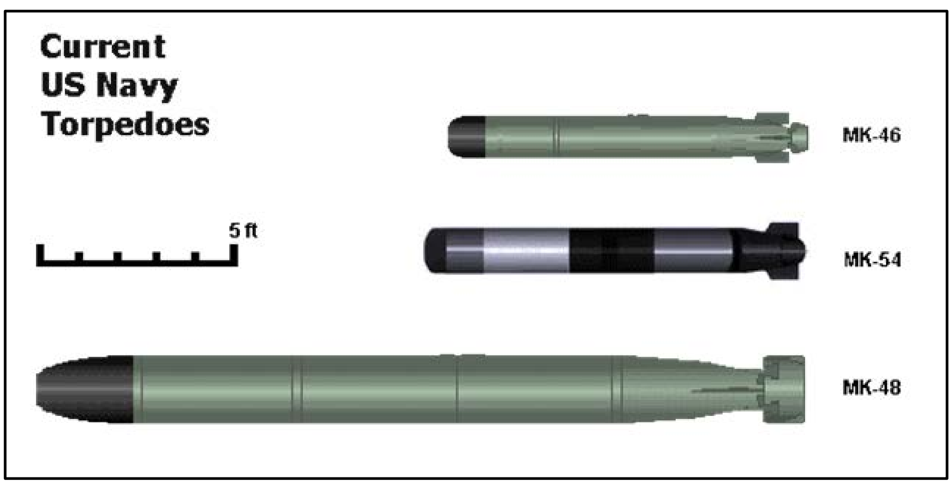
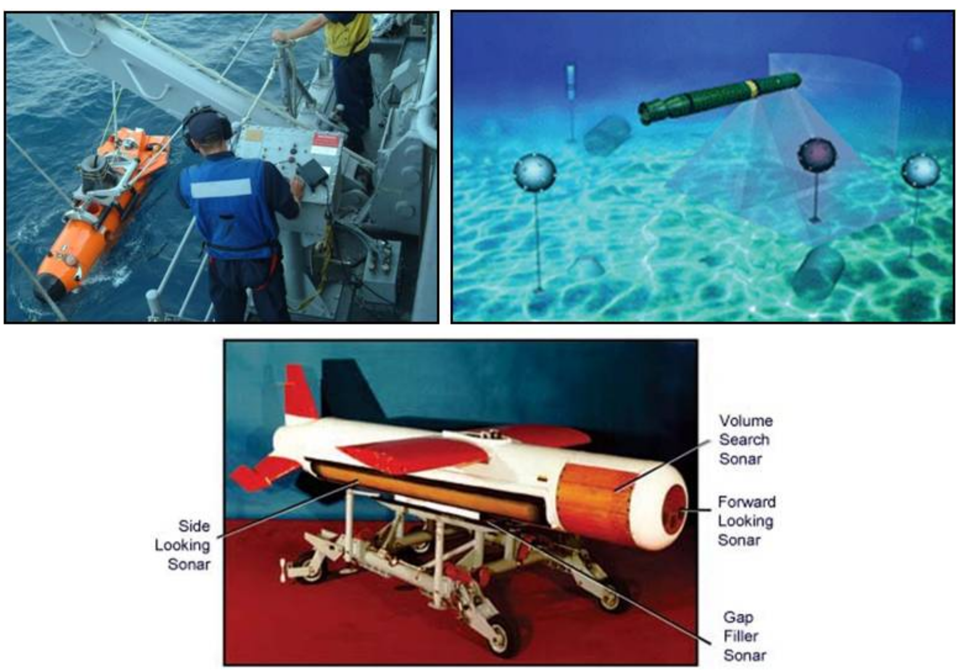


Figure A.1-6: Current United States Navy Torpedoes

- **Anti-Submarine Warfare Targets:** Anti-submarine warfare targets are autonomous undersea vehicles used to simulate target submarines (Figure A.1-7). The targets are equipped with one or more of the following devices: (1) acoustic projectors emitting sounds to simulate submarine acoustic signatures, (2) echo repeaters to simulate the characteristics of the echo of a sonar signal reflected from a submarine, or (3) magnetic sources that mimic those of a submarine.

Figure A.1-7: Anti-Submarine Warfare Targets

Mine Warfare. Mine warfare training and testing activities use a variety of different sonar systems that are typically high-frequency (greater than 10 kHz) and very high-frequency (greater than 100 kHz). These sonar systems are used to detect, locate, and characterize moored and bottom mines (Figure A.1-8). The majority of mine warfare sonar sensors can be deployed by more than one platform (e.g., helicopter, unmanned underwater vehicle, or surface ship) and may be interchangeable among platforms. Surface ships and submarines use sonar to detect mines and objects, while minesweeping ships use a specialized variable-depth mine detection and classification high-frequency active sonar system to detect mines.



(Source: Graphic on right courtesy of Lockheed Martin)

Figure A.1-8: Mine Warfare Systems

Safety, Navigation, Communications, and Oceanographic Systems. Naval ships, submarines, and unmanned surface and subsurface vehicles rely on equipment and instrumentation that use active sonar during both routine operations and training and testing events. Sonar systems are used to gauge water depth; detect and map objects, navigational hazards, and the ocean floor; and transmit communication signals.

Other Acoustic Systems. The Navy uses a variety of other acoustic sensors to protect ships anchored or at the pier, as well as shore facilities. These systems, both active and passive, detect potentially hostile swimmers, broadcast warnings to alert Navy divers of potential hazards, and gather information regarding ocean characteristics (ocean currents and wave measurements). They are generally stationary systems in Navy harbors and piers. Navy marine mammals (Atlantic bottlenose dolphins [*Tursiops truncatus*] and California sea lions [*Zalophus californianus*]) are also used to detect hostile swimmers around Navy facilities. A trained animal is deployed under behavioral control of a handler to find an intruding swimmer. Upon finding the "target" of the search, the animal returns to the boat and alerts the animal handlers, and the animals are given a localization marker or leg cuff that they attach to the intruder. Swimmers that have been marked with a leg cuff are reeled in by security support craft personnel via a line attached to the cuff. In addition, the Navy's research and acquisition community uses various sensors for tracking during testing activities and to collect data for test analysis.

A.1.2 MUNITIONS

Most munitions used during training and testing events fall into three basic categories: projectiles, missiles, and bombs. Munitions can be further defined by their net explosive weight, which is the actual weight in pounds of the explosive substance without the packaging, casings, bullets, etc. Net explosive weight is also the trinitrotoluene (TNT) equivalent of energetic material, which is the standard measure of strength of bombs and other explosives. For example, a 2,000-pound (lb.) bomb may have anywhere from 600 to 1,000 lb. of net explosive weight.

Projectiles. Projectiles are fired during gunnery exercises and testing events from a variety of weapons, ranging from pistols and rifles to large-caliber, turret-mounted guns on the decks of Navy ships. Projectiles can be either high-explosive munitions (e.g., certain cannon shells), or non-explosive practice munitions (e.g., rifle/pistol bullets). Explosive rounds can be fused to either explode on impact or in the air (i.e., just prior to impact). Projectiles are broken down into three basic categories in this EIS/OEIS:

- **Small-Caliber Projectiles:** These projectiles are up to and including 0.50 caliber. Small-caliber projectiles (e.g., bullets) are primarily fired from pistols, rifles, and machine guns (i.e., small arms) and mostly during training events for an individual Sailor to become and remain proficient (Figure A.1-9).

Figure A.1-9: Shipboard Small Arms Training

- **Medium-Caliber Projectiles:** These projectiles are larger than 0.50 caliber but smaller than 57 millimeter (mm) (approximately 2- to ¼-inch (in.) diameter). The most common size medium-caliber projectiles are 20 mm, 25 mm, and 40 mm. Medium-caliber projectiles are fired from machine guns operated by one to two crewman and mounted on the deck of a ship, wing-mounted guns on aircraft, and fully automated guns mounted on ships for defense against missile attack (Figure A.1-10). Medium-caliber projectiles also include 40 mm grenades, which can be fired from hand-held grenade launchers or crew-served deck-mounted guns. Medium-caliber projectiles can be non-explosive practice munitions or high-explosive projectiles. High-explosive projectiles are usually fused to detonate on impact; however, advanced high-explosive projectiles can detonate based on time, distance, or proximity to a target.

Figure A.1-10: Shipboard Medium-Caliber Guns

- **Large-Caliber Projectiles:** These include projectiles 57 mm and larger. The largest projectile currently in service has a 5-in. (12.7-centimeter) diameter, but larger weapons are under development. The most widely used large-caliber projectiles are 57 mm and 5 in. (Figure A.1-11). The most common 5-in. projectile is approximately 26 in. long and weighs 70 lb. Large-caliber projectiles are fired exclusively from turret-mounted guns located on ship decks and can be used to fire on surface ships and boats, in defense against missiles and aircraft, and against land-based targets. Large-caliber projectiles can be non-explosive practice munitions or explosive munitions. High-explosive projectiles can detonate on impact or in the air.

Figure A.1-11: Shipboard Large-Caliber Gun and Projectiles

Missiles. Missiles are rocket or jet-propelled munitions used to attack ships, aircraft, and land-based targets, as well as defend ships against other missiles. Guidance systems and advanced fusing technology ensure that missiles reliably impact on or detonate near their intended target. Missiles are categorized according to their intended target, as described below, and can be further classified according to net explosive weight. Rockets are included within the category of missiles.

- **Air Missiles:** Air missiles are fired from ships and aircraft against enemy aircraft and incoming missiles (Figure A.1-12). Air missiles are configured to explode in the air near, or on impact with, their intended target. Missiles are the primary ship-based defense against incoming missiles.


Figure A.1-12: Rolling Airframe Missile and Air-to-Air Missile

- **Surface Missiles:** Surface missiles are fired from aircraft, ships, and submarines against surface ships (Figure A.1-13). Surface missiles are typically configured to detonate on impact or just above the intended target.

Figure A.1-13: Anti-Surface Missile Fired from MH-60 Helicopter

- **Anti-Radiation Missiles:** The AGM-88 High-Speed Anti-Radiation Missile, used to destroy enemy radar sites, is fired at a floating sea-borne target that replicates a land-based radar site.
- **Rockets:** Rockets are fired from helicopters against water and land-based targets. Rockets can either be laser guided or unguided, and while most contain inert warheads there are high-explosive variants that detonate on impact or flechette warheads that open at the conclusion of rocket motor burnout and contain approximately 1,180 60-grain flechettes.

Bombs. Bombs are unpowered munitions dropped from aircraft on land and water targets. The majority of bombs used during training and testing in the Study Area are non-explosive. However, explosive munitions are occasionally used for proficiency inspections and testing requirements. Bombs fall into two categories: general-purpose bombs and subscale practice bombs. Similar to missiles, bombs are further classified according to their net explosive weight.

- **General-Purpose Bombs:** General-purpose bombs consist of precision-guided and unguided full-scale bombs, ranging in size from 250 to 2,000 lb. (Figure A.1-14). Common bomb nomenclature used includes: MK 80 series, which is the Navy's standard model; Guided Bomb Units and Joint Direct Attack Munitions, which are precision-guided (including laser guided) bombs; and the Joint Standoff Weapon, which is a long-range "glider" precision weapon. General-purpose bombs can be either non-explosive practice munitions or high explosive.

Figure A.1-14: F/A-18 Bomb Release and Loading General Purpose Bombs

- **Subscale Bombs:** Subscale bombs (Figure A.1-15) are non-explosive practice munitions containing a spotting (smoke) charge to aid in scoring the accuracy of hitting the target during training and testing activities. Common subscale bombs are 25 lb. and less and are steel-constructed. Laser guided training rounds are another variation of a subscale practice bomb. They weigh approximately 100 lb. and are cost-effective non-explosive weapons used in training aircrew in laser-guided weapons employment.

Figure A.1-15: Subscale Bombs for Training

Other Munitions. There are other munitions used in naval at-sea training and testing events that do not fit into one of the above categories and are discussed below:

- **Demolition Charges:** Divers place explosive charges in the marine environment during some training and testing activities. These activities may include the use of timed charges, in which the charge is placed, a timer is started, and the charge detonates at the set time. Munitions of up to 60-lb. blocks of composition 4 (C-4) plastic explosive, with the necessary detonators and cords, are used to support mine neutralization, demolition, and other warfare activities. The vast majority of underwater detonations involve explosive charges of 20 lb. or less in size. All demolition charges are further classified according to the net explosive weight of the charge.
- **Anti-Swimmer Grenades:** Maritime security forces use hand grenades to defend against enemy scuba divers.

- **Torpedoes:** Explosive torpedoes are required in some training and testing events. Torpedoes are described as either lightweight or heavyweight and are further categorized according to the net explosive weight.
- **Extended Echo Ranging Sonobuoys:** Extended Echo Ranging sonobuoys include mini sound-source seeker sonobuoys that use small explosive charges as the active sound source instead of electrically produced sounds. Extended Echo Ranging sonobuoys are only used in testing activities.

A.1.3 TARGETS

Training and testing require an assortment of realistic and challenging targets. Targets vary from items as simple and ordinary as an empty steel drum used for small-caliber weapons training from the deck of a ship, to sophisticated, unmanned aerial drones used in air defense training. For this EIS/OEIS, targets are organized by warfare area.

Air Warfare Targets: Air warfare targets, tow target systems, and aerial targets are used in training and testing events that involve detection, tracking, defending against, and attacking enemy missiles and aircraft. Aerial tow target systems include textile (nylon banner) and rigid (fiberglass shapes) towed targets used for gunnery events. Aerial targets include expendable ballistic targets and recoverable radio-controlled drones used for gunnery and missile exercises (Figure A.1-16). Parachute flares are used as air-to-air missile targets. Manned high-performance aircraft may be used as targets—to test ship and aircraft defensive systems and procedures—without the actual firing of munitions.

Figure A.1-16: Deployment and Recovery of Air Warfare Targets

Surface Warfare Targets: Floating, towed, and mobile targets are used as surface warfare targets during gunnery events. Targets include floating steel drums, inflatable shapes or target balloons (e.g., Killer Tomato™) (Figure A.1-17), and towed sleds. High-speed targets, such as jet skis and motorboats, are also used (Figure A.1-18).

Figure A.1-17: Deploying a "Killer Tomato™" Floating Target

Figure A.1-18: Ship Deployable Surface Target and High-Speed Maneuverable Seaborne Target

Anti-Submarine Warfare Targets: Anti-submarine warfare uses multiple types of targets, including the following:

- **Submarines:** Submarines may act as tracking and detection targets during training and testing events.
- **Motorized Autonomous Targets:** Motorized autonomous targets simulate the acoustic and magnetic characteristics of a submarine, providing realism for exercises when a submarine is not available. There are two types of mobile targets, one is designed for recovery and reuse, while the other is expendable.
- **Stationary Artificial Targets:** Stationary targets either resemble submarine hulls or are simulated systems with acoustic properties of enemy submarines. These targets either rest on the seafloor or are suspended at varying depths in the water column.

Mine Warfare Targets: Mine targets are used in training activities that involve the detection, location, and neutralization of mines in the water. There are a wide variety of mine targets that mimic floating, bottom, and moored mines. All mine targets are made out of inert material.

A.1.4 Defensive Countermeasures

Naval forces depend on effective defensive countermeasures to protect against missile and torpedo attack. Defensive countermeasures are devices designed to confuse, distract, and confound precision-guided munitions. Defensive countermeasures fall into five basic categories:

- **Chaff:** Chaff consists of reflective, aluminum-coated glass fibers used to obscure ships and aircraft from radar-guided systems. Chaff, which is stored in canisters, is either dispensed from aircraft or fired into the air from the decks of surface ships when an attack is imminent. The glass fibers create a radar cloud that masks the position of the ship or aircraft.
- **Flares:** Flares are pyrotechnic devices used to defend against heat-seeking missiles, where the missile seeks out the heat signature from the flare rather than the aircraft's engines. Similar to chaff, flares are also dispensed from aircraft and fired from ships.
- **Acoustic Countermeasures:** Acoustic countermeasures are used by surface ships and submarines to defend against torpedo attack (Figure A.1-19). Acoustic countermeasures are either released from ships and submarines or towed at a distance behind the ship.
- **Electromagnetic Countermeasures:** Electromagnetic countermeasures are used by surface ships and aircraft to defend against missile attacks. Electromagnetic countermeasures are also used in anti-submarine warfare activities.
- **Biodegradable Polymer:** Biodegradable polymer is a biodegradable vessel entanglement technology used to slow or stop specific maritime targets by entangling the propulsion mechanism.

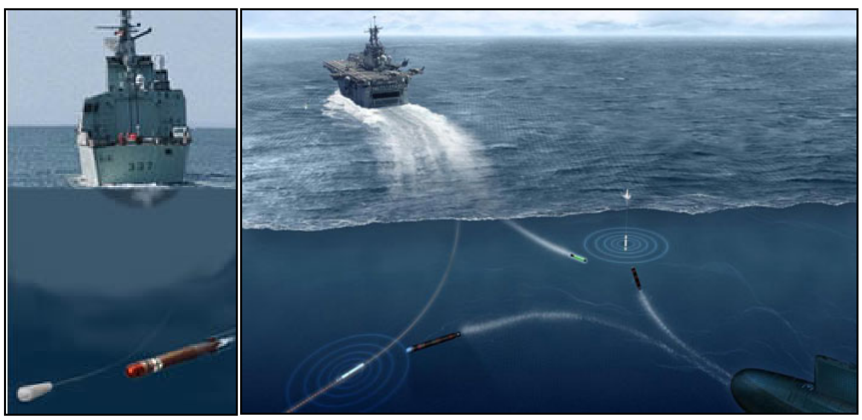


Figure A.1-19: Acoustic Countermeasures

A.1.5 Mine Warfare Systems

Mine warfare systems fall into two broad categories: mine detection and mine neutralization.

Mine Detection Systems. Mine detection systems are used to locate, classify, and map suspected mines. Once located, the mines can either be neutralized or avoided. These systems are specialized to either locate mines on the surface, in the water column, or on the sea floor.

- **Towed or Hull-Mounted Mine Detection Systems:** These detection systems use acoustic and laser or video sensors to locate and classify suspect mines. Helicopters, ships, and unmanned vehicles are used for towed systems, which can rapidly assess large areas (Figure A.1-20).

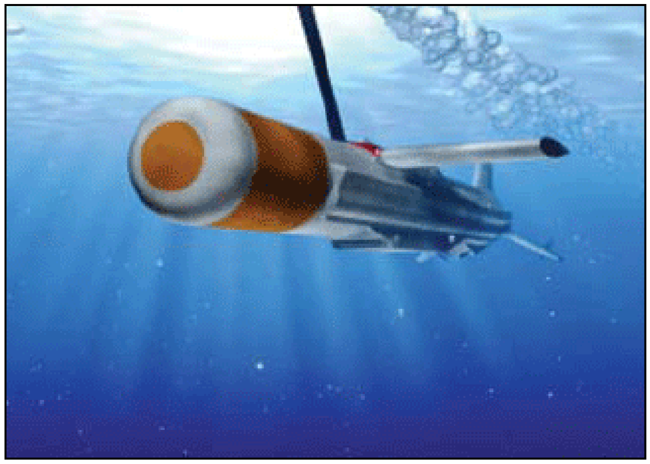


Figure A.1-20: Towed Mine Detection System

- **Airborne Laser Mine Detection Systems:** Airborne laser detection systems work in concert with neutralization systems. The detection system initially locates mines, and a neutralization system is then used to relocate and neutralize the mine (Figure A.1-21).

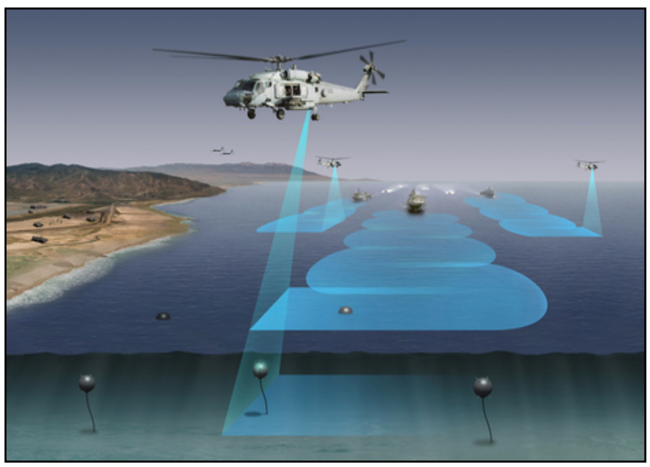


Figure A.1-21: AN/AES-1 Airborne Laser Mine Detection System

- **Unmanned/Remotely Operated Vehicles:** These vehicles use acoustic, video, or lasers, or combinations thereof, to locate and classify mines. Unmanned/remotely operated vehicles provide unique mine warfare capabilities in nearshore littoral areas, surf zones, ports, and channels.
- **Marine Mammal System:** Navy personnel and Navy marine mammals work together to detect specified underwater objects. The Navy deploys trained bottlenose dolphins and California sea lions as part of the marine mammal minehunting and object recovery system.

Mine Neutralization Systems. These systems disrupt, disable, or detonate mines to clear ports and shipping lanes, as well as littoral, surf, and beach areas in support of naval amphibious operations. Mine neutralization systems can clear individual mines or a large number of mines quickly.

- **Towed Influence Mine Sweep Systems:** These systems use towed equipment that mimics a particular ship's magnetic and acoustic signature, triggering the mine and causing it to explode (Figure A.1-22).

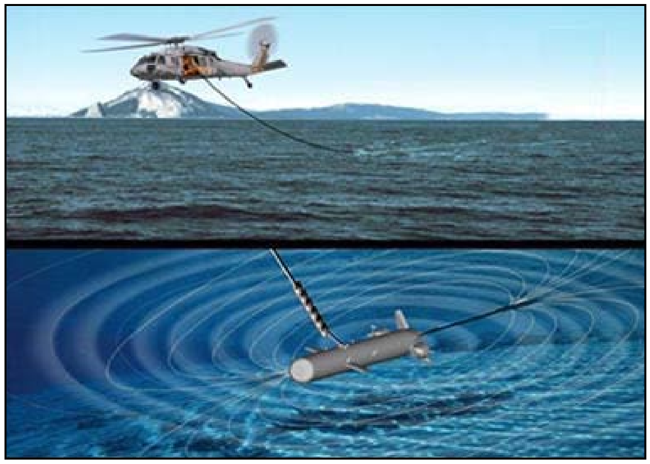


Figure A.1-22: Organic and Surface Influence Sweep

- **Towed Mechanical Mine Sweeping Systems:** These systems tow a sweep wire to snag the line that attaches a moored mine to its anchor and then uses a series of cables and cutters to sever those lines. Once these lines are cut, the mines float to the surface where explosive ordnance personnel can neutralize the mines.
- **Unmanned/Remotely Operated Mine Neutralization Systems:** Surface ship and helicopters operate these systems, which place explosive charges near or directly against mines to destroy the mine (Figure A.1-23).

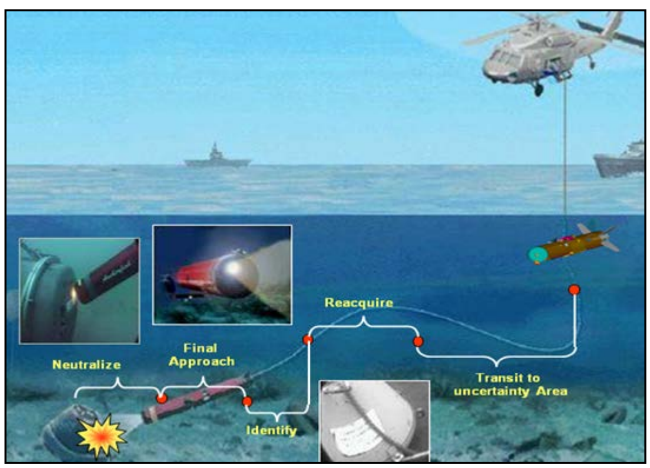


Figure A.1-23: Airborne Mine Neutralization System

- **Projectiles:** Small- and medium-caliber projectiles fired from surface ships or hovering helicopters are used to neutralize floating and near-surface mines.
- **Diver-Placed Explosive Charges:** Operating from small craft, divers place explosive charges, which may use time-delay fusing, near or on mines to destroy the mine or disrupt its ability to function.

A.1.6 Military Expended Materials

Navy training and testing events may introduce or expend various items, such as non-explosive munitions and targets, into the marine environment as a direct result of using these items for their intended purpose. In addition to the items described below, some accessory materials—related to the carriage or release of these items—may be released. These materials, referred to as military expended materials, are not recovered and potentially result in environmental impacts. These impacts are analyzed in detail in Chapter 3 (Affected Environment and Environmental Consequences) of this EIS/OEIS. This section includes descriptions of a representative sample of military expended materials. A more comprehensive discussion can be found in Chapter 3 (Affected Environment and Environmental Consequences).

Military expended materials analyzed in this document include the following:

- **Sonobuoys:** Sonobuoys consist of decelerators/parachutes, wires, and the sonobuoys themselves.
- **Bathythermographs:** Bathythermographs as used by the Navy are similar to sonobuoys in that they consist of decelerators/parachutes, wires, and the buoy themselves. In the case of bathythermographs, the buoys are used to measure temperature information of the water column and transmit that information to the platform (usually a ship or aircraft) that deployed the bathythermograph.
- **Torpedo Launch Accessories:** Torpedoes are usually recovered; however, materials such as decelerators/parachutes used with air-dropped torpedoes, guidance wire used with submarine-launched torpedoes, and ballast weights are expended. Explosive-filled torpedoes expend torpedo fragments.
- **Projectiles and Bombs:** Non-explosive projectiles, non-explosive bombs, or fragments from explosive projectiles and bombs are expended during training and testing events. These items are primarily constructed of lead (most small-caliber projectiles) or steel (medium- and large-caliber projectiles and all bombs). Casings are expended as a result of firing either non-explosive or explosive projectiles.
- **Blank Ammunition:** Blank ammunition is used in some training activities when the sound or flash of gunfire adds to the realism of the training activity but safety of personnel or nearby civilians is critical. Blank ammunition contains gunpowder, but no projectile is sent downrange upon firing the weapon. Casings are expended as a result of firing blank ammunition.
- **Missiles and Rockets:** Non-explosive missiles and missile fragments from explosive missiles are expended during training and testing events. Propellant, and any explosive material involved, is consumed during firing/detonation. Rockets are similar to missiles and both non-explosive and fragments may be expended.
- **Countermeasures:** Countermeasures (acoustic, chaff, flares, and biodegradable polymer) are expended as a result of training or testing events, with the exception of towed acoustic countermeasures. Chaff activities also include an expended canister, end caps, and pistons. Flares expend only end caps and pistons.
- **Targets:** Some targets are designed to be expended; other targets, such as aerial drones and remote-controlled boats, are recovered for re-use. Targets struck with munitions will result in target fragments.

A.2 Training Activities

The Navy's training activities are organized generally into seven primary mission areas and a miscellaneous category ("Other Training") that includes those activities that do not fall within a primary mission area but are an essential part of Navy training. The locations listed are the areas where the training typically takes place, but they can occur through the AFTT Study Area shown on Figure 2.1-1

(Atlantic Fleet Training and Testing Study Area) in Chapter 2 (Description of Proposed Action and Alternatives). In addition, because the Navy conducts a number of activities within larger training exercises, descriptions of those larger exercises are also included here. It is important to note that these larger exercises are composed entirely of individual activities described in the primary mission areas.

A.2.1 MAJOR TRAINING EXERCISES

A major anti-submarine warfare training exercise comprises several "unit-level" range exercises conducted by several units operating together while commanded and controlled by a single commander. These exercises typically employ an exercise scenario developed to train and evaluate the strike group in naval tactical tasks. In a major training exercise, most of the operations and activities being directed and coordinated by the strike group commander are identical in nature to the operations conducted during individual, crew, and smaller-unit training events. In a major training exercise, however, these disparate training tasks are conducted in concert, rather than in isolation.

Major training exercises are listed below.

A.2.1.1 Composite Training Unit Exercise

Major Training Exercises – Large Integrated Anti-Submarine Warfare			
Composite Training Unit Exercise			
Short Description	Aircraft carrier and carrier air wing integrate with surface and submarine units in a challenging multi-threat operational environment that certifies them ready to deploy.	**Typical Duration**	21 days
Long Description	Intermediate level carrier strike exercise designed to create a cohesive strike group prior to deployment or Joint Task Force Exercise. Typically employs seven surface ships, fixed-wing aircraft and helicopters, two submarines, and various unmanned vehicles. Each strike group performs a rehearsal called Composite Training Unit Exercise before deployment. Prior to the Composite Training Unit Exercise, each ship and aircraft in the strike group trains in their specialty. The Composite Training Unit Exercise is an intermediate-level strike group exercise designed to forge the group into a cohesive fighting team. Composite Training Unit Exercise normally consists of an 18-day schedule of event-driven exercise, and a 3-day Final Battle Problem. The Composite Training Unit Exercise is an integration phase, at-sea, major training exercise. For the Carrier Strike Group, this exercise integrates the aircraft carrier and carrier air wing with surface and submarine units in a challenging operational environment. Special operations training may also be integrated with the exercise scenario. For Composite Training Unit Exercise only, the anti-submarine warfare activities were analyzed as a Composite Training Unit Exercise. Other warfare area training conducted during the Composite Training Unit Exercise is analyzed elsewhere as unit-level training (gunnery exercises, missile exercises, etc.).		
Typical Components	**Platforms:** Aircraft carriers, fixed-wing aircraft, rotary-wing aircraft, submarines, surface combatants **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems		

Major Training Exercises – Large Integrated Anti-Submarine Warfare			
Composite Training Unit Exercise			
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosive:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	 Chemicals other than explosives
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Decelerator/parachute - Small **Non-Ingestible Material:** Acoustic countermeasures, expendable bathythermographs, expendable bathythermograph wires, sonobuoys (non-explosive), sonobuoy wires	**Military Recoverable Material**	Sub-surface targets (mobile)
Sonar and Other Transducer Bins	**Low-Frequency:** LF6 **Mid-Frequency:** MF1 MF5 MF3 MF11 MF4 MF12 **High-Frequency:** HF1	**Anti-Submarine Warfare:** ASW1 ASW4 ASW2 ASW5 ASW3	
In-Water Explosive Bins	Analyzed in individual unit-level training events.		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	

Major Training Exercises – Large Integrated Anti-Submarine Warfare	
Composite Training Unit Exercise	
Assumptions Used for Analysis	For Composite Training Unit Exercise, only the anti-submarine warfare activities were analyzed as a Composite Training Unit Exercise. Other warfare area training conducted during the Composite Training Unit Exercise was analyzed as unit-level training (gunnery exercise, missile exercise, etc.). Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.

A.2.1.2 Fleet Exercise/Sustainment Exercise

Included in the Fleet Response Training Plan is a requirement to conduct post-deployment training, and maintenance. This ensures that the components of a strike group maintain an acceptable level of readiness after returning from deployment. A sustainment exercise is an exercise designed to challenge the strike group in all warfare areas. Marine mammal systems may be used during the exercise. This exercise is similar to a Composite Training Unit Exercise but is of shorter duration.

<table>
<tr><th colspan="4">Major Training Exercises – Medium Integrated Anti-Submarine Warfare</th></tr>
<tr><th colspan="4">Fleet Exercise/Sustainment Exercise</th></tr>
<tr><td>Short Description</td><td colspan="2">Aircraft carrier and carrier air wing integrates with surface and submarine units in a challenging multi-threat operational environment to maintain ability to deploy.</td><td>Typical Duration
Up to 10 days</td></tr>
<tr><td>Long Description</td><td colspan="3">Fleet Exercises and Sustainment Exercises are similar in scope to Composite Training Unit Exercises but shorter in duration and use fewer active sonar hours. Fleet Exercises are integrated joint and coalition training exercises designed to maintain proficiency across maritime warfare disciplines. Sustainment Exercises are conducted to ensure that Carrier Strike Group maintains an acceptable level of readiness after returning from deployment in order to maintain a surge capability. Marine mammal systems may be used during the exercise.
Use of other munitions and explosives in the Fleet Exercises and Sustainment Exercises is included in unit-level events.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Aircraft carriers, fixed-wing aircraft, rotary-wing aircraft, submarines, surface combatants
Targets: Sub-surface targets
Systems being Trained/Tested: Sonar systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Navy Cherry Point
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Sonar and other transducers
Aircraft noise
Vessel noise
Explosives:
None</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessels and in-water device strike
Military expended material
Ingestion:
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices
In-water electromagnetic devices
Entanglement:
Wires and cables
Decelerators/parachutes</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Metals
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Decelerator/parachute - Small
Non-Ingestible Material:
Acoustic countermeasures, sonobuoys (non-explosive), sonobuoy wires</td><td>Military Recoverable Material</td><td>Sub-surface targets (mobile)</td></tr>
</table>

Major Training Exercises – Medium Integrated Anti-Submarine Warfare	
Fleet Exercise/Sustainment Exercise	
Sonar and Other Transducer Bins	**Low-Frequency:** LF6 **Mid-Frequency:** MF1 MF5 MF3 MF11 MF4 MF12 **Anti-Submarine Warfare:** ASW1 ASW4 ASW2 ASW3 **High-Frequency:** HF1
In-Water Explosive Bins	Analyzed in individual unit-level training events.
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Only the anti-submarine warfare activities were analyzed as a Fleet Exercise/Sustainment Exercise. Other warfare area training conducted during the Fleet Exercise/Sustainment Exercise was analyzed as unit-level training (gunnery exercise, missile exercise, etc.). Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.

A.2.2 Integrated/Coordinated Training

Integrated or coordinated anti-submarine warfare training exercises are similar to major training exercises in that they are composed of several basic, unit-level exercises, training conducted by an individual unit, but are generally on a smaller scale, are of shorter duration, and use fewer hours of active sonar than a major training exercise.

A.2.2.1 Navy Undersea Warfare Training Assessment Course

Small Integrated Anti-Submarine Warfare Training		
Navy Undersea Warfare Training Assessment Course		
Short Description	Multiple ships, aircraft, and submarines integrate the use of their sensors, including sonobuoys, to search for, detect, classify, localize, and track a threat submarine.	**Typical Duration** 2-5 days
Long Description	The Navy Undersea Warfare Training Assessment Course is a tailored course of instruction designed to improve Sea Combat Commander and strike group integrated anti-submarine warfare warfighting skill sets. Navy Undersea Warfare Training Assessment Course is a coordinated training scenario that typically involves five surface ships, two to three embarked helicopters, a submarine, and one maritime patrol aircraft searching for, locating, and attacking one submarine. The scenario consists of two 12-hour exercises that occur five times per year. The submarine may practice simulated attacks against the ships while being tracked. Hull-mounted, towed array, and dipping sonar is employed by ships and helicopters. The submarine also periodically operates its sonar.	
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, submarines, surface combatants **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville, Navy Cherry Point, Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material strike **Ingestion:** Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Chemicals other than explosives
Stressors to Human Resources	None	
Military Expended Material	**Ingestible Material:** Decelerator/parachute - Small **Non-Ingestible Material:** Sub-surface targets (mobile), sonobuoys (non-explosive), sonobuoy wires	**Military Recoverable Material** Sub-surface targets (mobile)

Small Integrated Anti-Submarine Warfare Training	
Navy Undersea Warfare Training Assessment Course	
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1, MF3, MF4, MF5, MF12 **High-Frequency:** HF1 **Low-Frequency:** LF6 **Anti-Submarine Warfare:** ASW1, ASW3, ASW4
In-Water Explosive Bins	Analyzed in individual unit-level training events.
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Two MK-39 Expendable Mobile Anti-Submarine Warfare Training Targets may be used in place of an actual submarine target. Air deployed sonobuoys will have a decelerator/parachute. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.

A.2.2.2 Surface Warfare Advanced Tactical Training

<table>
<tr><th colspan="4">Small Integrated Anti-Submarine Warfare Training</th></tr>
<tr><th colspan="4">Surface Warfare Advanced Tactical Training</th></tr>
<tr><td>Short Description</td><td>Multiple ships and aircraft coordinate the use of sensors, including sonobuoys, to search, detect, and track a threat submarine. Surface Warfare Advanced Tactical Training exercises are not dedicated anti-submarine warfare exercises and involve multiple warfare areas.</td><td colspan="2">Typical Duration
Up to 15 days</td></tr>
<tr><td>Long Description</td><td colspan="3">Surface Warfare Advanced Tactical Training (SWATT) is an intermediate training exercise designed primarily to increase operator proficiency and exercise combined force responses to surface warfare, anti-submarine warfare, air warfare and electromagnetic spectrum operations.
Surface Warfare Advanced Tactical Training is conducted after a carrier strike group's first Group Sail, and before Composite Training Unit Exercise, and consists of multiple surface warfare, anti-submarine and air warfare live fire events. Multiple ships and aircraft search for, locate, and track one submarine. Occurs once per carrier strike group training cycle.
Use of other munitions and explosives in SWATT are included in unit-level events.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Surface combatants, fixed-wing aircraft, rotary-wing aircraft, unmanned vehicles, submarines
Targets: Sub-surface targets
Systems being Trained/Tested: Sonar systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Navy Cherry Point
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Sonar and other transducers
Aircraft noise
Vessel noise

Explosives:
None

Physical Disturbance and Strike:
Vessels and in-water device strike
Military expended material strike

Ingestion:
Military expended materials – other than munitions

Energy:
In-air electromagnetic devices
In-water electromagnetic devices

Entanglement:
Wires and cables
Decelerators/parachutes</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Metals
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Target fragments, decelerators/parachutes - small

Non-Ingestible Material:
Sonobuoys (non-explosive), sonobuoy wires, acoustic countermeasures, sub-surface targets (mobile)</td><td>Military Recoverable Material</td><td>Sub-surface targets (mobile)</td></tr>
</table>

Small Integrated Anti-Submarine Warfare Training	
Surface Warfare Advanced Tactical Training	
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF5MF1K MF6 MF3 MF12 MF4 **Anti-Submarine Warfare:** ASW2 ASW4 ASW3 **High-Frequency:** HF1 **Acoustic Modems:** M3
In-Water Explosive Bins	Analyzed in individual unit-level training events.
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Only the anti-submarine warfare activities were analyzed as a SWATT. Other warfare area training conducted during SWATT was analyzed as unit-level training (gunnery exercises, missile exercises, etc.). Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.

A.2.2.3 Anti-Submarine Warfare Tactical Development Exercise

Medium Coordinated Anti-Submarine Warfare Training			
Anti-Submarine Warfare Tactical Development Exercise			
Short Description	Multiple ships, aircraft, and submarines coordinate their efforts to search for, detect, and track submarines with the use of all sensors. Anti-Submarine Warfare Tactical Development Exercise is a dedicated anti-submarine warfare exercise.	**Typical Duration** 5-7 days	
Long Description	Multiple ships, aircraft, and submarines coordinate their efforts to search for, detect, and track submarines with the use of all sensors. Anti-Submarine Warfare Tactical Development Exercise is a fleet training exercise involving surface ships, submarines, and aircraft. Active and passive sonar and sonobuoys are used to conduct anti-submarine warfare training exercises. The purpose of the exercise is to assess fleet anti-submarine warfare performance and capability among various units operating together in a specific threat environment.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, surface combatants, submarines **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, sonobuoys, acoustic countermeasures		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	Chemicals other than explosives
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Target fragments, decelerators/parachutes - small **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, acoustic countermeasures	**Military Recoverable Material**	Sub-surface targets (mobile)
Sonar and Other Transducer Bins	**Low-Frequency:** LF6 **Mid-Frequency:** MF1 MF5 MF3 MF11 MF4 MF12	**High-Frequency:** HF1 **Anti-Submarine Warfare:** ASW1 ASW4 ASW3	**Acoustic Modems:** M3

Medium Coordinated Anti-Submarine Warfare Training	
Anti-Submarine Warfare Tactical Development Exercise	
In-Water Explosive Bins	Analyzed in individual unit-level training events.
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Only the anti-submarine warfare activities were analyzed as an Anti-Submarine Warfare Tactical Development Exercise. Other warfare area training conducted during the exercise was analyzed as unit-level training. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.

A.2.2.4 Amphibious Ready Group Marine Expeditionary Unit Exercise

Small Coordinated Anti-Submarine Warfare Training			
Amphibious Ready Group Marine Expeditionary Unit Exercise			
Short Description	Navy and Marine Corps forces conduct advanced training at sea in preparation for deployment.	**Typical Duration** 5-7 days	
Long Description	Amphibious ships and embarked Marine Expeditionary Units train to a multitude of scenarios to test the capabilities of the amphibious force. Operations include ship to shore movement with tiltrotor aircraft and Landing Craft Air Cushion vessels. Marine Corps forces conduct more advanced amphibious operations to include small boat raids; visit, board, search, and seizure training; helicopter and mechanized amphibious raids; and non-combatant evacuation operations. This exercise generally occurs during an Expeditionary Strike Group Composite Training Unit Exercise. All military expended materials, explosives, and use of other munitions in Amphibious Ready Group Marine Expeditionary Unite Exercise are included in unit-level events.		
Typical Components	**Platforms:** Amphibious warfare ships, fixed-wing aircraft, rotary-wing aircraft, small boats, surface combatants, tiltrotor aircraft **Targets:** None **Systems Being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	Chemicals other than explosives
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Decelerator/parachute -Small **Non-Ingestible Material:** Sonobuoys, acoustic countermeasures	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Low-Frequency:** LF6 **Mid-Frequency:** MF1 MF11 MF3 MF12	**High-Frequency:** HF1 **Anti-Submarine Warfare:** ASW1	
In-Water Explosive Bins	Analyzed in individual unit-level training events.		

Small Coordinated Anti-Submarine Warfare Training		
Amphibious Ready Group Marine Expeditionary Unit Exercise		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Only the anti-submarine warfare activities were analyzed as Amphibious Ready Group Marine Expeditionary Unit training. Other warfare area training conducted during the exercise was analyzed as unit-level training. Sonar is not used during every exercise. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.	

A.2.2.5 Group Sail

Small Coordinated Anti-Submarine Warfare	
Group Sail	
Short Description	Surface ships and helicopters integrate to search for, detect, and track threat submarines. Group Sails are not dedicated anti-submarine warfare exercises and involve multiple warfare areas.
Typical Duration	2-3 days
Long Description	Multiple ships and helicopters integrate the use of their sensors, including sonobuoys, to search for, detect, classify, localize, and track threat submarines. While Group Sail is not a dedicated anti-submarine warfare exercise and involves multiple warfare areas, only the anti-submarine warfare activities were analyzed as a Group Sail. Other warfare area training conducted during a Group Sail is analyzed elsewhere as unit-level training. Group Sail is an intermediate training exercise primarily intended to introduce coordinated operations after unit-level training and prior to integrated training. This exercise stresses planning, coordination, and communications during multiple warfare training scenarios. Two or more ships and up to two helicopters search for, locate, and attack one submarine. Typically, one ship and helicopter are actively prosecuting while the other ship and helicopter are repositioning. Simultaneously, the submarine may practice simulated attacks against the ships. Multiple acoustic sources may be active at one time.
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, surface combatants, submarines **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, sonobuoys, acoustic countermeasures
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety
Typical Locations	**Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions **Energy:** In-water electromagnetic devices In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediments and Water Quality:** Metals Chemicals other than explosives
Stressors to Human Resources	None
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - Small **Non-Ingestible Material:** Acoustic countermeasures, sonobuoys (non-explosive), sonobuoy wires, expendable bathythermographs, expendable bathythermograph wires, sub-surface targets (mobile)
Military Recoverable Material	Sub-surface targets (mobile)

Small Coordinated Anti-Submarine Warfare	
Group Sail	
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1, MF3, MF4, MF5, MF11, MF12 **Anti-Submarine Warfare:** ASW2, ASW3, ASW4 **High-Frequency:** HF1
In-Water Explosive Bins	Analyzed in individual unit-level training events.
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	While the preference will be to train against an actual submarine or MK 30 recoverable target, assume only MK 39 expendable targets will be used. One MK 39 Expendable Mobile Anti-Submarine Warfare Training Target may be used in place of an actual submarine target. Only the anti-submarine warfare activities were analyzed as Group Sail training. Other warfare area training conducted during the exercise was analyzed as unit-level training. Additional activities utilizing sources not listed in the Sonar and Other Transducer Bins section above may occur during this exercise. All acoustic sources that may be used during training and testing activities have been accounted for in the modeling and analysis presented in this EIS/OEIS.

A.2.3 Air Warfare Training

Air warfare is the primary mission area that addresses combat operations by air and surface forces against hostile aircraft. Navy ships contain an array of modern anti-aircraft weapon systems, including naval guns linked to radar-directed fire-control systems, surface-to-air missile systems, and radar-controlled cannon for close-in point defense. Strike/fighter aircraft carry anti-aircraft weapons, including air-to-air missiles and aircraft cannon. Air warfare training encompasses events and exercises to train ship and aircraft crews in employment of these weapons systems against simulated threat aircraft or targets. Air warfare training includes surface-to-air gunnery, surface-to-air and air-to-air missile exercises, and aircraft force-on-force combat maneuvers.

A.2.3.1 Air Combat Maneuver

Air Warfare			
Air Combat Maneuver			
Short Description	Fixed-wing aircrews aggressively maneuver against threat aircraft to gain tactical advantage.	**Typical Duration**	1-2 hours
Long Description	Basic flight maneuvers in which fixed-wing aircrew engage in offensive and defensive maneuvering against each other. During air combat maneuver engagements, no munitions are fired, however countermeasures such as chaff and flares may be used. These maneuvers typically involve two aircraft; however, based upon the training requirement, air combat maneuver exercises may involve over a dozen aircraft.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Air targets **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None

Air Warfare	
Air Combat Maneuver	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	No munitions are fired. Flares and chaff may be used. All flares and chaff are accounted for in flare exercise and chaff exercise.

A.2.3.2 Air Defense Exercise

Air Warfare			
Air Defense Exercise			
Short Description	Aircrew and ship crews conduct defensive measures against threat aircraft or simulated missiles.	**Typical Duration** 1-4 hours	
Long Description	Fixed-wing aircrew and ship personnel perform measures designed to defend against attacking threat aircraft or missiles or reduce the effectiveness of such attack. This exercise involves full detection through engagement sequence. Aircraft operate at varying altitudes and speeds. This exercise may include air intercept control exercises where aircraft controllers on ships, in fixed-wing aircraft or at land based locations use search radars to track and direct friendly aircraft to intercept the threat aircraft, and detect to engage exercises where personnel on ships use search radars to detect, classify, and track enemy aircraft or missiles up to the point of engagement.		
Typical Components	**Platforms:** Fixed-wing aircraft, surface combatants **Targets:** Air targets **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	No munitions are fired.		

A.2.3.3 Gunnery Exercise Air-to-Air Medium-Caliber

Air Warfare			
Gunnery Exercise Air-to-Air Medium-Caliber			
Short Description	Fixed-wing aircrews fire medium-caliber guns at air targets.	**Typical Duration**	1-2 hours
Long Description	Fixed-wing aircrews maneuver aircraft in a gunnery pattern to achieve a weapons firing solution with integrated medium-caliber guns. Typically involves two or more fixed-wing aircraft and a target banner towed by a contract aircraft (e.g., Lear jet). The target banner is recovered after the exercise.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Air targets **Systems being Trained/Tested:** Medium-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material strike **Ingestion:** Military expended materials – munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** Medium-caliber projectiles (non-explosive), medium-caliber casings **Non-Ingestible Material:** None	**Military Recoverable Material**	Towed air targets
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		

Air Warfare	
Gunnery Exercise Air-to-Air Medium-Caliber	
Assumptions Used for Analysis	This activity is conducted at an altitude of 15,000 ft. and above, during the daytime, and approximately 40 NM from shore. A towed air target is a banner target and will be recovered. Only non-explosive munitions used.

A.2.3.4 Gunnery Exercise Surface-to-Air Large-Caliber

Air Warfare			
Gunnery Exercise Surface-to-Air Large-Caliber			
Short Description	Surface ship crews fire large-caliber guns at air targets.	**Typical Duration**	1-2 hours
Long Description	Surface ship crews defend against threat aircraft or missiles with large-caliber guns to disable or destroy the threat. An exercise involves one ship and a simulated threat aircraft or missile that is detected by the ship's radar. Large-caliber guns fire non-explosive projectiles at the threat before it reaches the ship. The target is towed by a contract air services jet.		
Typical Components	**Platforms:** Aircraft carriers, amphibious warfare ships, fixed-wing aircraft, surface combatants **Targets:** Air targets **Systems being Trained/Tested:** Large-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material **Ingestion:** Military expended material – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Air Target (Decoy) - fragments **Non-Ingestible Material:** Large-caliber projectiles (non-explosive), large-caliber casings	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing noise	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Air Warfare	
Gunnery Exercise Surface-to-Air Large-Caliber	
Assumptions Used for Analysis	The target is a fiberglass finned target that is towed approximately 3 NM behind the towing aircraft. All projectiles are assumed to be non-explosive. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.3.5 Gunnery Exercise Surface-to-Air Medium-Caliber

<table>
<tr><td colspan="3">Air Warfare</td></tr>
<tr><td colspan="3">Gunnery Exercise Surface-to-Air Medium-Caliber</td></tr>
<tr><td>Short Description</td><td>Surface ship crews fire medium-caliber guns at air targets.</td><td>Typical Duration
1-2 hours</td></tr>
<tr><td>Long Description</td><td colspan="2">Surface ship crews defend against threat aircraft or missiles with medium-caliber guns to disable or destroy the threat.
An exercise involves one ship and a simulated threat aircraft or anti-ship missile that is detected by the ship's radar. Medium-caliber guns fire non-explosive projectiles to disable or destroy the threat before it reaches the ship. The target is towed by a contract air services jet.</td></tr>
<tr><td>Typical Components</td><td colspan="2">Platforms: Aircraft carriers, amphibious warfare ships, surface combatants, fixed-wing aircraft
Targets: Air targets
Systems being Trained/Tested: Medium-caliber gun systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Weapons firing safety</td><td>Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Navy Cherry Point
Virginia Capes
Other AFTT Areas
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="2">Acoustic:
Aircraft noise
Vessel noise
Weapons noise

Explosives:
None

Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessels and in-water device strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions

Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Metals Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="2">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Medium-caliber projectiles (non-explosive), medium-caliber casings, air target (decoy) fragments

Non-Ingestible Material:
None</td><td>Military Recoverable Material
None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="2">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="2">None</td></tr>
</table>

Air Warfare	
Gunnery Exercise Surface-to-Air Medium-Caliber	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	The target is a fiberglass finned target that is towed approximately 3 NM behind the towing aircraft. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.3.6 Missile Exercise Air-to-Air

Air Warfare			
Missile Exercise Air-to-Air			
Short Description	Fixed-wing aircrews fire air-to-air missiles at air targets	**Typical Duration**	1-2 hours
Long Description	An exercise involves two or more fixed-wing aircraft and a target. Missiles are either explosive warheads or non-explosive practice munitions. The target is an unmanned aerial target drone, a tactical air-launched decoy, or a parachute suspended illumination flare. Target drones deploy parachutes and are recovered by small boat or rotary-wing aircraft; tactical air-launched decoys and illumination flares are expended and not recovered. These exercises typically occur at high altitudes.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, small boats **Targets:** Air targets, flares **Systems being Trained/Tested:** Missile and rocket systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material Vessel & in-water device strike **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Decelerators/ parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	None		

Air Warfare			
Missile Exercise Air-to-Air			
Military Expended Material	**Ingestible Material:** Missiles (explosive) and air target (decoy) and (drone) fragments **Non-Ingestible Material:** Illumination flares, missiles (non-explosive), decelerators/parachutes – medium, large and extra-large	**Military Recoverable Material**	Air target (drone)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	For analysis, all missiles are assumed to be explosive, although non-explosive practice munitions may be used. All missiles explode at high altitude. All propellant and explosives are consumed. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

Figure A.2-1: BQM-74 (Aerial Target)

Figure A.2-2: LUU-2B/B Illuminating Flare (Aerial Target)

Figure A.2-3: Tactical Air-Launched Decoy (Aerial Target)

A.2.3.7 Missile Exercise – Man-Portable Air Defense System

Air Warfare		
Missile Exercise – Man-Portable Air Defense System		
Short Description	Personnel employ a shoulder fired surface to air missile at air targets.	**Typical Duration** Varies
Long Description	Personnel employ the Man-Portable Air Defense Systems, a shoulder fired surface to air missile, against threat missiles or aircraft. An exercise involves personnel firing the Man-Portable Air Defense System at remote piloted or ballistic aerial targets. Activity is typically conducted by combat forces firing from shore locations at targets over the water. Small boats are used to ensure range safety.	
Typical Components	**Platforms:** Small boats **Targets:** Air targets **Systems being Trained/Tested:** Man-Portable Defense Systems	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety Unmanned aerial, surface and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Weapons noise Vessel noise **Explosives:** In-air explosives **Physical Disturbance and Strike:** Aircraft and aerial target strike Vessels and in-water device strike Military expended material	**Ingestion:** Military expended material – munitions Military expended material – other than munitions **Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Other materials Metals
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strikes **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strikes	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** Missile (explosive) fragments, air target (drone) fragments **Non-Ingestible Material:** None	**Military Recoverable Material** None
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	

Air Warfare	
Missile Exercise – Man-Portable Air Defense System	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive missiles and rockets Vessel movement
Assumptions Used for Analysis	For analysis, all missiles are assumed to be explosive, although non-explosive practice munitions may be used. All missiles explode in-air at low altitude. All propellant and explosives are consumed.

A.2.3.8 Missile Exercise Surface-to-Air

<table>
<tr><th colspan="4">Air Warfare</th></tr>
<tr><th colspan="4">Missile Exercise Surface-to-Air</th></tr>
<tr><td rowspan="2">Short Description</td><td rowspan="2" colspan="2">Surface ship crews fire surface-to-air missiles at air targets.</td><td>Typical Duration</td></tr>
<tr><td>1-2 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Surface ship crews defend against threat missiles and aircraft with ship launched surface-to-air missiles. The exercise involves a simulated threat aircraft, anti-ship missile, or land attack missile, which is detected by the ship's radar. Ship launched surface-to-air missiles are fired (high-explosive) to disable or destroy the threat. The target typically is a remote controlled drone. Target drones deploy parachutes and are recovered by small boat or rotary-wing aircraft; when used, tactical air-launched decoys are not recovered.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Aircraft carriers, amphibious warfare ships, surface combatants
Targets: Air targets
Systems being Trained/Tested: Surface-to-air missile systems</td></tr>
<tr><td rowspan="2">Standard Operating Procedures
(Section 2.3.3)</td><td rowspan="2">Vessel safety
Aircraft safety
Weapons firing safety</td><td colspan="2">Typical Locations</td></tr>
<tr><td>Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Northeast
Virginia Capes</td><td>Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Vessel noise
Weapons noise

Explosives:
In-air explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended material

Ingestion:
Military expended material – munitions
Military expended material – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
Decelerators/parachutes</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants</td><td>Sediments and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Other materials
Metals</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Missile (explosive) fragments, air target (drone) and (decoy) fragments

Non-Ingestible Material:
Decelerators/parachutes - large</td><td>Military Recoverable Material</td><td>Air target (drone)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
</table>

Air Warfare	
Missile Exercise Surface-to-Air	
Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Assumes that all surface-to-air missiles are high-explosive. Missile explodes well above the water's surface. All explosive and propellant are consumed. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.4 Amphibious Warfare Training

Amphibious warfare is a type of naval warfare involving the utilization of naval firepower, logistics, and Marine Corps landing forces to project military power ashore. Amphibious warfare encompasses a broad spectrum of activities involving maneuver from the sea to objectives ashore, ranging from reconnaissance or raid missions involving a small unit to large-scale amphibious operations involving over 1,000 Marines and Sailors and multiple ships and aircraft embarked in a strike group.

Amphibious warfare training includes tasks at increasing levels of complexity, from individual, crew, and small unit events to large task force exercises. Individual and crew training include the operation of amphibious vehicles and naval gunfire support training. Small-unit training activities include shore assaults, boat raids, airfield or port seizures, and reconnaissance. Larger-scale amphibious exercises involve ship-to-shore maneuver, shore bombardment and other naval fire support, and air strike and close air support training.

A.2.4.1 Amphibious Assault

Amphibious Warfare			
Amphibious Assault			
Short Description	Large unit forces move ashore from amphibious ships at sea for the immediate execution of inland objectives.	**Typical Duration** Up to 2 weeks	
Long Description	Large unit forces move ashore from amphibious ships at sea for the immediate execution of inland objectives. Amphibious assault is conducted for the purposes of prosecuting further combat operations, obtaining a site for an advanced naval or airbase, or denying the enemy use of an area. Unit-level training exercises involve one or more amphibious ships, and their associated watercraft and aircraft, to move personnel and equipment from ship to shore without the command and control and supporting elements involved in a full scale exercise. The goal is to practice loading, unloading, and movement and to develop the timing required for a full-scale exercise.		
Typical Components	**Platforms:** Amphibious warfare ships, fixed-wing aircraft, rotary-wing aircraft, small boats, tiltrotor aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strikes	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strikes	**Public Health and Safety:** Physical interactions In-air energy

<table>
<tr><th colspan="4">Amphibious Warfare</th></tr>
<tr><th colspan="4">Amphibious Assault</th></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">None</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement</td></tr>
<tr><td>Assumptions Used for Analysis</td><td colspan="3">Typical exercise: 1-3 amphibious ships (e.g., LHA or LHD, LPD, LSD); 2-8 landing craft (landing craft, air cushion; landing craft, utility); 4-14 amphibious assault vehicles; up to 22 aircraft (e.g., MH-53, H-46/MV-22, AH-1, UH-1, AV-8); a Marine Expeditionary Unit (2,200 Marines).</td></tr>
</table>

A.2.4.2 Amphibious Marine Expeditionary Unit Integration Exercise

Amphibious Warfare			
Amphibious Marine Expeditionary Unit Integration Exercise			
Short Description	Navy and Marine Corps forces conduct integration training at sea in preparation for deployment.	**Typical Duration**	Up to 3 weeks
Long Description	Amphibious ships and Marine Expeditionary Unit integrate for the first time at sea to practice amphibious tactics, techniques, and procedures. Navy and Marine Corps forces conduct basic amphibious operations to include small boat raids; visit, board, search, and seizure training; helicopter and mechanized amphibious raids.		
Typical Components	**Platforms:** Amphibious warfare ships, fixed-wing aircraft, rotary-wing aircraft, small boats, tiltrotor aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Weapons firing during this exercise is discussed under descriptions of appropriate unit-level exercises (e.g., surface-to-surface and air-to-surface small-caliber gunnery exercises).		

A.2.4.3 Amphibious Raid

Amphibious Warfare			
Amphibious Raid			
Short Description	Small unit forces move from amphibious ships at sea for a specific short-term mission. These are quick operations with as few personnel as possible.	**Typical Duration** 4-8 hours	
Long Description	Small unit forces swiftly move from amphibious vessels at sea into hostile territory for a specific mission, including a planned withdrawal. Raids are conducted to inflict loss or damage, secure information, create a diversion, confuse the enemy, or capture or evacuate individuals or material. Amphibious raid forces are kept as small as possible to maximize stealth and speed of the operation. An event may employ assault amphibian vehicle units, small boats, small unit live-fire and non-live-fire operations. Surveillance or reconnaissance unmanned surface and aerial vehicles may be used during this exercise.		
Typical Components	**Platforms:** Amphibious warfare ships, small boats, unmanned aerial systems **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		

Amphibious Warfare	
Amphibious Raid	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Weapons firing during this exercise is discussed in appropriate unit-level training descriptions (e.g., surface-to-surface and air-to-surface small-caliber gunnery exercises).

A.2.4.4 Amphibious Vehicle Maneuvers

Amphibious Warfare			
Amphibious Vehicle Maneuvers			
Short Description	Small boat crews practice the employment of amphibious vehicles.	**Typical Duration**	1-4 hours
Long Description	Navy personnel train to learn handling characteristics of a variety of amphibious craft, to include Landing Craft Air Cushion vehicles, amphibious assault vehicles, and Lighter Amphibious Resupply Cargo vehicles. Training includes the driving of vehicles into the water, basic in-water vehicle maneuvers, and the driving of vehicles back to shore.		
Typical Components	**Platforms:** Amphibious vehicles, small boats **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes Jacksonville	**Inshore Waters/Pierside:** Lower Chesapeake Bay St. Johns River
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.2.4.5 Humanitarian Assistance Operations

Amphibious Warfare			
Humanitarian Assistance Operations			
Short Description	Military units evacuate noncombatants from hostile or unsafe areas or provide humanitarian assistance in times of disaster.	**Typical Duration**	12 hours
Long Description	Military units evacuate noncombatants from hostile or unsafe areas to safe havens or to provide humanitarian assistance in times of disaster. Non-Combatant Evacuation Operation is conducted by military units (generally Marine Corps) usually operating in conjunction with Navy ships and aircraft. Non-combatants are evacuated when their lives are endangered by war, civil unrest, or natural disaster. Military units train for evacuations in hostile environments that require the use of force, though usually there is no opposition to evacuation from the host country. Helicopters and landing crafts could be expected to participate in this operation during day or night.		
Typical Components	**Platforms:** Amphibious warfare ships, rotary-wing aircraft, tiltrotor aircraft, small boats **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.2.4.6 Marine Expeditionary Unit Certification Exercise

<table>
<tr><th colspan="4">Amphibious Warfare</th></tr>
<tr><th colspan="4">Marine Expeditionary Unit Certification Exercise</th></tr>
<tr><td rowspan="2">Short Description</td><td rowspan="2">Amphibious Ready Group exercises are conducted to validate the Marine Expeditionary Unit's readiness for deployment and include small boat raids; visit, board, search, and seizure training; helicopter and mechanized amphibious raids; and non-combatant evacuation operations.</td><td colspan="2">Typical Duration</td></tr>
<tr><td colspan="2">Up to 3 weeks</td></tr>
<tr><td>Long Description</td><td colspan="3">Marine Corps amphibious forces move from amphibious ships at sea, by watercraft or aircraft, and introduce a landing force, establish a beachhead, and occupy the area or move further inland for an extended period.

The amphibious assault conducted by a Marine Expeditionary Unit involves employment of the advance force, combat, combat support, and combat service support units in close coordination with the expeditionary strike group and carrier strike group. The landing is conducted in waves and is focused on concentrating forces quickly in order to establish the beachhead. A typical exercise involves two reinforced companies from the battalion landing team coming ashore via landing crafts and amphibious assault vehicles. Follow-on waves include fire support assets, armored units, and service support elements.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Amphibious warfare ships, fixed-wing aircraft, rotary-wing aircraft, small boats, tiltrotor aircraft
Targets: None
Systems being Trained/Tested: None</td></tr>
<tr><td rowspan="2">Standard Operating Procedures (Section 2.3.3)</td><td rowspan="2">Vessel safety
Aircraft safety</td><td colspan="2">Typical Locations</td></tr>
<tr><td>Range Complexes/Testing Ranges:
Navy Cherry Point</td><td>Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Aircraft noise
Vessel noise

Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike

Energy:
In-air electromagnetic devices

Explosives:
None

Ingestion:
None

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediment and Water Quality:
None</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">Cultural Resources:
Physical disturbance and strike

Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike

Public Health and Safety:
Physical interactions
In-air energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
</table>

Amphibious Warfare	
Marine Expeditionary Unit Certification Exercise	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Weapons firing during this exercise is discussed in appropriate unit-level exercise descriptions (e.g., surface-to-surface and air-to-surface small-caliber gunnery exercises).

A.2.4.7 Naval Surface Fire Support Exercise – At Sea

Amphibious Warfare			
Naval Surface Fire Support Exercise – At Sea			
Short Description	Surface ship crews fire large-caliber guns at a passive acoustic hydrophone scoring system.	**Typical Duration**	1-2 hours of firing, 8 hours total
Long Description	Surface ship crews use large-caliber guns to support forces ashore; however, the land target is simulated at sea. Rounds are scored by passive acoustic buoys located at or near the target area. The portable scoring system is composed of buoys (Integrated Maritime Portable Acoustic Scoring and Simulation System) set in a pre-designed pattern at specific intervals, which are retrieved after the exercise. A scoring system provides a realistic presentation, such as a land mass with topography, to the vessel's combat system. This virtual land target area overlays the hydrophone array. The vessel fires its munitions into the target area and the acoustic noise resulting from the impact of the round landing in the water is detected by the hydrophones. The scoring system triangulates the exact point of impact of the round, allowing the exercise to be conducted as if the vessel were firing at an actual land target. Surface ship crews use large-caliber (main battery) guns to support forces ashore.		
Typical Components	**Platforms:** Surface combatants **Targets:** Surface targets **Systems being Trained/Tested:** Large-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Large-caliber projectiles, large-caliber casings	**Military Recoverable Material**	Surface target (stationary)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		

Amphibious Warfare		
Naval Surface Fire Support Exercise – At Sea		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing noise	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions
Assumptions Used for Analysis	Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.	

A.2.4.8 Naval Surface Fire Support Exercise – Land-Based Target

Amphibious Warfare			
Naval Surface Fire Support Exercise – Land-Based Target			
Short Description	Surface ship crews fire large-caliber guns at land-based targets in support of forces ashore.	**Typical Duration** 1-2 hours	
Long Description	Surface ship crews use large-caliber guns to support forces ashore. One or more ships position themselves from three to six NM from the target area and a land-based spotter relays type and exact location of the target. After observing the fall of the shot, the spotter relays any adjustments needed to reach the target. Once the rounds are on target, the spotter requests a sufficient number to effectively destroy the target. This exercise occurs on land ranges where explosive and non-explosive practice munitions are authorized and is often supported by target shapes such as tanks, trucks, trains, or aircraft on the ground.		
Typical Components	**Platforms:** Surface combatants **Targets:** Land targets **Systems being Trained/Tested:** Large-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Large-caliber projectiles (casings only)	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing noise	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Amphibious Warfare	
Naval Surface Fire Support Exercise – Land-Based Target	
Assumptions Used for Analysis	Projectile impact is on land and is not further analyzed. No land based impacts are included in this document. Firing point from sea is Area 15B. Impact occurs at G-10 Impact Area, Camp Lejeune.

A.2.5 Anti-Submarine Warfare Training

Anti-submarine warfare involves helicopter and maritime patrol aircraft, ships, and submarines. These units operate alone or in combination to locate, track, and neutralize submarines. Controlling the undersea battlespace is a unique naval capability and a vital aspect of sea control. Undersea battlespace dominance requires proficiency in anti-submarine warfare. Every deploying strike group and individual surface combatant must possess this capability.

Various types of active and passive sonar are used by the Navy to determine water depth, and identify, track, and target submarines. Passive sonar "listens" for sound waves by using underwater microphones, called hydrophones, which receive, amplify, and process underwater sounds. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character, and movement of submarines. However, passive sonar provides only a bearing (direction) to a sound-emitting source; it does not provide an accurate range (distance) to the source. Active sonar is needed to locate objects because active sonar provides both bearing and range to the detected contact (such as an enemy submarine).

The Navy's anti-submarine warfare training plan, including the use of active sonar in at-sea training scenarios, includes multiple levels of training. Individual-level anti-submarine warfare training addresses basic skills such as detection and classification of contacts; distinguishing discrete acoustic signatures including those of ships, submarines, and marine life; and identifying the characteristics, functions, and effects of controlled jamming and evasion devices.

More advanced, integrated anti-submarine warfare training exercises involving active sonar are conducted in coordinated, at-sea operations during training exercises involving submarines, ships, aircraft, and helicopters. This training integrates the full anti-submarine warfare continuum, from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons. Training events include detection and tracking exercises against "enemy" submarine contacts, torpedo employment exercises against the target, and exercising command and control tasks in a multi-dimensional battlespace.

A.2.5.1 Torpedo Exercise – Helicopter

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Exercise – Helicopter			
Short Description	Helicopter crews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	**Typical Duration**	2-5 hours
Long Description	Helicopters using sonobuoys and dipping sonar search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a torpedo and destroy the submarine. Sonobuoys (both passive and active) are typically employed by a helicopter operating at altitudes below 3,000 ft. Dipping sonar (both passive and active) is employed from an altitude of about 50 ft. after the search area has been narrowed based on the sonobuoy search. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 target, or a live submarine. This exercise may involve a single aircraft, or occur during a coordinated larger exercise involving multiple aircraft and ships, including a major range event. Unmanned aerial systems, such as the MQ-8 Fire Scout, may also be used. The exercise torpedo is recovered by a special recovery helicopter or small craft. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in other range complexes depending on training requirements and available assets.		
Typical Components	**Platforms:** Rotary-wing aircraft, unmanned aerial systems, small boats **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, sonobuoys, torpedo systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	Chemicals other than explosives
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Decelerators/parachutes- small **Non-Ingestible Material:** Lightweight torpedo accessories, sonobuoys (non-explosive), sonobuoy wires, marine markers, sub-surface targets (mobile)	**Military Recoverable Material**	Sub-surface targets (mobile), lightweight torpedoes (non-explosive)

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Exercise – Helicopter			
Sonar and Other Transducer Bins	**Mid-Frequency:** MF4 MF5	**Torpedoes:** TORP1	
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar		**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

A.2.5.2 Torpedo Exercise – Maritime Patrol Aircraft

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Exercise – Maritime Patrol Aircraft			
Short Description	Maritime patrol aircraft crews search for, track, and detect submarines. Recoverable air launched torpedoes are employed against submarine targets.	**Typical Duration**	2-8 hours
Long Description	Fixed-wing maritime patrol aircraft employ sonobuoys to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a torpedo and destroy the submarine. Sonobuoys (both passive and active) are typically employed by a maritime patrol aircraft operating at altitudes below 3,000 ft. Both sonobuoys and torpedoes (using the High Altitude Anti-Submarine Warfare Weapon Capability kit) may be delivered at high altitudes to remain clear of high threat areas. Sonobuoys are deployed in specific patterns based on the expected threat submarine and specific water conditions. Depending on these two factors, these patterns will cover many different size areas. For certain sonobuoys, tactical parameters of use may be classified. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 target, or a live submarine. This exercise may involve a single aircraft, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and vessels, including a major range event. The exercise torpedo is recovered by helicopter or small boat. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in other OPAREAs depending on training requirements and available assets.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, small boats **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonobuoys, torpedoes		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material Vessel and in-water device strike **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	Chemicals other than explosives
Stressors to Human Resources	None		

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Exercise – Maritime Patrol Aircraft			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes – small and medium **Non-Ingestible Material:** Lightweight torpedo accessories, sonobuoys (non-explosive), expended bathythermograph, expended bathythermograph wire, sonobuoy wires, sub-surface targets (mobile)	**Military Recoverable Material**	Sub-surface targets (mobile), lightweight torpedoes (non-explosive)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF5	**Torpedoes:** TORP1	
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	
Assumptions Used for Analysis	Submarine may provide service as the target. If target is air-dropped, one parachute per target. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

A.2.5.3 Torpedo Exercise – Ship

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Exercise – Ship			
Short Description	Surface ship crews search for, track, and detect submarines. Exercise torpedoes are used during this exercise.	**Typical Duration**	2-5 hours
Long Description	Surface ships search for, detect, and track threat submarines to determine a firing position to launch a torpedo and attack the submarine. A surface ship operates at slow speeds while employing hull-mounted or towed array sonar. Passive or active sonar is employed depending on the type of threat submarine, the tactical situation, and environmental conditions. The anti-submarine warfare target used for this exercise is a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, MK-30 Target, or live submarine. This exercise may involve a single ship, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event. The exercise torpedo is recovered by helicopter or small craft. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in other range complexes depending on training requirements and available assets.		
Typical Components	**Platforms:** Rotary-wing aircraft, small boats, surface combatants **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures, torpedoes		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	Chemicals other than explosives
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, expendable bathythermographs, expendable bathythermograph wires, lightweight torpedo accessories, sub-surface targets (mobile)	**Military Recoverable Material**	Sub-surface targets (mobile), lightweight torpedoes (non-explosive)

Anti-Submarine Warfare		
Anti-Submarine Warfare Torpedo Exercise – Ship		
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1	**Anti-Submarine Warfare:** ASW3 **Torpedoes:** TORP1
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	
Assumptions Used for Analysis	Submarines may provide service as the target. Torpedoes are recovered. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.	

A.2.5.4 Torpedo Exercise – Submarine

Anti-Submarine Warfare	
Anti-Submarine Warfare Torpedo Exercise – Submarine	
Short Description	Submarine crews search for, track, and detect submarines. Exercise torpedoes are used during this exercise. **Typical Duration** 8 hours
Long Description	Submarine crews search for, detect and track a threat submarine to develop firing position to launch a torpedo. A single submerged submarine operates at slow speeds and various depths while using its hull mounted or towed array sonar to track a threat submarine. Passive sonar is used almost exclusively. Non-explosive exercise torpedoes can be fired and active sonar can be used during this training exercise. This exercise may involve a single submarine, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event. The exercise torpedo is recovered by helicopter or small craft. The preferred range for this exercise is an instrumented underwater range, but it may be conducted in other range complexes depending on training requirements and available assets.
Typical Components	**Platforms:** Rotary-wing aircraft, small boats, submarines **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures, torpedoes
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Towed in-water device safety **Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Northeast Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material Aircraft and aerial target strike **Ingestion:** None **Energy:** None **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria pollutants **Sediments and Water Quality:** Metals
Stressors to Human Resources	None
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Guidance wires, heavyweight torpedo accessories, expended bathythermograph, expended bathythermograph wires, acoustic countermeasures
Military Recoverable Material	Sub-surface targets (mobile), heavyweight torpedoes (non-explosive)

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Exercise – Submarine			
Sonar and Other Transducer Bins	**Mid-Frequency:** MF3 **High-Frequency:** HF1	**Anti-Submarine Warfare:** ASW4 **Torpedoes:** TORP2	
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar		**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Torpedoes are recovered. Guidance wire has a low tensile strength and breaks easily. Weights and flex tubing sink rapidly. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

A.2.5.5 Tracking Exercise – Helicopter

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Exercise – Helicopter			
Short Description	Helicopter crews search for, track, and detect submarines.	**Typical Duration**	2-4 hours
Long Description	Helicopters using sonobuoys and dipping sonar search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a torpedo and destroy the submarine. Sonobuoys (both passive and active) are typically employed by a helicopter operating at altitudes below 3,000 ft. Dipping sonar (both passive and active) is employed from an altitude of about 50 ft. after the search area has been narrowed based on the sonobuoy search. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-submarine Warfare Training Target, a MK-30 target, or a live submarine. This exercise may involve a single aircraft, or occur during a coordinated larger exercise involving multiple aircraft and ships, including a major range event. Unmanned aerial systems, such as the MQ-8 Fire Scout, may also be used. The preferred range for this exercise is an instrumented range, but it may be conducted in other range complexes depending on training requirements and available assets.		
Typical Components	**Platforms:** Rotary-wing aircraft, unmanned aerial systems **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, sonobuoys		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes Other AFTT Areas	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Decelerators/parachutes Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	Chemicals other than explosives
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, sub-surface targets (mobile), marine marker	**Military Recoverable Material**	Sub-surface targets (mobile)

Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Exercise – Helicopter		
Sonar and Other Transducer Bins	**Mid-Frequency:** MF4 MF5	
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Tracking exercise can occur in all locations. Submarines may provide service as the target. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.	

A.2.5.6 Tracking Exercise – Maritime Patrol Aircraft

Anti-Submarine Warfare	
Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft	
Short Description	Maritime patrol aircraft crews search for, track, and detect submarines. **Typical Duration:** 2-8 hours
Long Description	Fixed-wing maritime patrol aircraft employ sonobuoys to search for, detect, classify, localize, and track a simulated threat submarine with the goal of determining a firing solution that could be used to launch a torpedo and destroy the submarine. Sonobuoys (both passive and active) are typically employed by a maritime patrol aircraft operating at altitudes below 3,000 ft. However, sonobuoys may be released at higher altitudes. Sonobuoys are deployed in specific patterns based on the expected threat submarine and specific water conditions. Depending on these two factors, these patterns will cover many different size areas. For certain sonobuoys, tactical parameters of use may be classified. The anti-submarine warfare target used for this exercise may be a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, a MK-30 target, or a live submarine. This exercise may involve a single aircraft, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft and vessels, including a major range event.
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonobuoys, acoustic countermeasures
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety Unmanned aerial, surface, and subsurface vehicle safety **Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville; Navy Cherry Point; Northeast; Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers; Aircraft noise; Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike; Vessel and in-water device strike; Military expended material **Ingestion:** Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** Decelerators/parachutes; Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediments and Water Quality:** Metals; Chemicals other than explosives; Other materials
Stressors to Human Resources	None
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, expended bathythermograph, expended bathythermograph wire, sub-surface targets (mobile)
Military Recoverable Material	Sub-surface targets (mobile)

Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft		
Sonar and Other Transducer Bins	**Mid-Frequency:** MF5	**Anti-Submarine Warfare:** ASW2 ASW5
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	
Assumptions Used for Analysis	Tracking exercise can occur in all locations. Submarine may provide service as the target. If target is air-dropped, one parachute per target. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.	

A.2.5.7 Tracking Exercise – Submarine

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Exercise – Submarine			
Short Description	Submarine crews search for, track, and detect submarines.	**Typical Duration**	8 hours
Long Description	Submarine crews search for, detect, and track a threat submarine to develop firing position to launch a torpedo. A single submerged submarine operates at slow speeds and various depths while using its hull mounted sonar to track a threat submarine. Passive sonar is used almost exclusively. The target for this exercise is either an MK 39 expendable mobile anti-submarine warfare training target, MK 30 recoverable training target, or live submarine. This exercise may involve a single submarine, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event.		
Typical Components	**Platforms:** Submarines **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Northeast Virginia Capes Other AFTT Areas	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** None **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Sub-surface targets (mobile), expended bathythermograph, expended bathythermograph wire, acoustic countermeasures	**Military Recoverable Material**	Sub-surface targets (mobile)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF3 **High-Frequency:** HF1	**Anti-Submarine Warfare:** ASW4	

Anti-Submarine Warfare		
Anti-Submarine Warfare Tracking Exercise – Submarine		
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. For biological resource analysis, vessel noise and vessel strike are only analyzed for the periods while the submarines are surfaced, typically brief in nature. Mitigation measures related to vessel movement are only considered during the period of surfacing as well.	

A.2.5.8 Tracking Exercise – Ship

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Exercise – Ship			
Short Description	Surface ship crews search for, track, and detect submarines.	**Typical Duration**	2-4 hours
Long Description	Surface ships search for, detect, and track threat submarines to determine a firing position to launch a torpedo and attack the submarine. A surface ship operates at slow speeds while employing sonobuoys, hull-mounted sonars, or towed array sonar. Passive or active sonar is employed depending on the type of threat submarine, the tactical situation, and environmental conditions. The target for this exercise is either a MK-39 Expendable Mobile Anti-Submarine Warfare Training Target, MK-30 Recoverable Training Target, or live submarine. This exercise may involve a single ship, or be undertaken in the context of a coordinated larger exercise involving multiple aircraft, ships, and submarines, including a major range event.		
Typical Components	**Platforms:** Surface combatants **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Northeast Virginia Capes Other AFTT Areas	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** No	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Chemicals other than explosives Other materials	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Decelerators/parachutes – small **Non-Ingestible Material:** Sub-surface targets (mobile), expendable bathythermographs, expendable bathythermograph wires. sonobuoy (non-explosive), sonobuoy wires	**Military Recoverable Material**	Sub-surface targets (mobile)

<table>
<tr><th colspan="2">Anti-Submarine Warfare</th></tr>
<tr><th colspan="2">Anti-Submarine Warfare Tracking Exercise – Ship</th></tr>
<tr><td>Sonar and Other Transducer Bins</td><td>Mid-Frequency:
MF1
MF11
MF12

Anti-Submarine Warfare:
ASW1
ASW3</td></tr>
<tr><td>In-Water Explosive Bins</td><td>None</td></tr>
<tr><td>Procedural Mitigation Measures</td><td>Acoustic Stressors: (Section 5.3.2)
Active sonar

Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement
Towed in-water devices</td></tr>
<tr><td>Assumptions Used for Analysis</td><td>A submarine may provide service as the target.
Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.</td></tr>
</table>

A.2.6 Electronic Warfare

Electronic warfare is the mission area of naval warfare that aims to control use of the electromagnetic spectrum and to deny its use by an adversary. Typical electronic warfare activities include threat avoidance training, signals analysis for intelligence purposes, and use of airborne and surface electronic jamming devices to defeat tracking systems.

A.2.6.1 Counter Targeting Chaff Exercise – Aircraft

Electronic Warfare			
Counter Targeting Chaff Exercise – Aircraft			
Short Description	Fixed-wing aircraft and helicopter aircrews deploy chaff to disrupt threat targeting and missile guidance radars.	**Typical Duration**	1-2 hours
Long Description	Fixed-wing aircraft and helicopter aircrews deploy chaff to disrupt threat targeting and missile guidance radars. Fixed-wing aircraft and helicopter aircrews detect electronic targeting signals from threat radars or missiles, dispense chaff, and immediately maneuver to defeat the threat. The chaff cloud deceives the inbound missile and the aircraft clears away from the threat. Chaff is a radar reflector material made of thin, narrow, metallic strips cut in various lengths to elicit frequency responses, which deceive enemy radars. Chaff is employed to create a target that will lure enemy radar and weapons system away from the actual friendly platform.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations**	
		Range Complexes/Testing Ranges: Gulf of Mexico Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Per chaff: one chaff-air cartridge, one plastic endcap, chaff fibers **Non-Ingestible Material:** None	**Military Recoverable Material**	None

Electronic Warfare	
Counter Targeting Chaff Exercise – Aircraft	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	Chaff is usually expended while conducting other training activities, such as air combat maneuvering. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.6.2 Counter Targeting Chaff Exercise – Ship

Electronic Warfare			
Counter Targeting Chaff Exercise – Ship			
Short Description	Surface ship crews deploy chaff to disrupt threat targeting and missile guidance radars.	**Typical Duration** 1-2 hours	
Long Description	Surface ship crews deploy chaff to disrupt threat targeting and missile guidance radars to defend against an attack. Surface ship crews detect electronic targeting signals from threat radars or missiles, dispense chaff, and immediately maneuver to defeat the threat. The chaff cloud deceives the inbound missile and the vessel clears away from the threat. The typical exercise duration is approximately 1.5 hours. Chaff is a radar reflector material made of thin, narrow, metallic strips cut in various lengths to elicit frequency responses, which deceive enemy radars. Chaff is employed create a target that will lure enemy radar and weapons system away from the actual friendly platform. Ships may also train with advanced countermeasure systems, such as the MK 53 Decoy Launching System (Nulka).		
Typical Components	**Platforms:** Surface combatants, amphibious warfare ships **Targets:** Air target **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Chaff-ship fibers **Non-Ingestible Material:** Chaff-ship cartridges, air target (decoy)	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		

Electronic Warfare	
Counter Targeting Chaff Exercise – Ship	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.6.3 Counter Targeting Flare Exercise

Electronic Warfare			
Counter Targeting – Flare Exercise			
Short Description	Fixed-wing aircraft and helicopter aircrews deploy flares to disrupt threat infrared missile guidance systems.	**Typical Duration**	1-2 hours
Long Description	Fixed-wing aircraft and helicopter aircrews deploy flares to disrupt threat infrared missile guidance systems. Aircraft detect electronic targeting signals from threat radars or missiles or a threat missile plume when launched and dispense flares and immediately maneuver to defeat the threat. This exercise trains aircraft personnel in the use of defensive flares designed to confuse infrared sensors or infrared homing missiles, thereby causing the sensor or missile to lock onto the flares instead of the real aircraft. Typically an aircraft will expend five flares in an exercise while operating above 3,000 ft. Flare exercises are often conducted with chaff exercises, rather than as a stand-alone exercise.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Other materials Chemicals other than explosives	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Per flare: one casing, one compression pad or one plastic piston, one plastic endcap, one O-ring **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		

Electronic Warfare	
Counter Targeting – Flare Exercise	
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	Approximately five flares per aircraft are expended per exercise. All combustible material in flares is assumed to be consumed before contact of the casing with the water. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.6.4 Electronic Warfare Operations

Electronic Warfare			
Electronic Warfare Operations			
Short Description	Aircraft and surface ship crews control portions of the electromagnetic spectrum used by enemy systems to degrade or deny the enemy's ability to take defensive actions.	**Typical Duration**	1-2 hours
Long Description	Aircraft and surface ship crews control the electromagnetic spectrum used by enemy systems to degrade or deny the enemy's ability to take defensive actions. Electronic Warfare Operations can be active or passive, offensive or defensive. Fixed-wing aircraft employ active jamming and deception against enemy search radars to mask the friendly inbound strike aircraft mission. Surface ships detect and evaluate enemy electronic signals from enemy aircraft or missile radars, evaluate courses of action concerning the use of passive or active countermeasures, then use ship maneuvers and either chaff, flares, active electronic countermeasures, or a combination of them to defeat the threat.		
Typical Components	**Platforms:** Fixed-wing aircraft, surface combatants **Targets:** Air targets, electronic warfare targets **Systems being Trained/Tested:** Radar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		

Electronic Warfare	
Electronic Warfare Operations	
Assumptions Used for Analysis	All chaff and flares involved in this exercise are covered under chaff exercises and flare exercises, respectively.

A.2.6.5 High-Speed Anti-Radiation Missile Exercise (Air-to-Surface)

Electronic Warfare			
High Speed Anti-Radiation Missile Exercise (Air-to-Surface)			
Short Description	Aircrews launch a High-Speed Anti-Radiation Missile against threat radar sites.	**Typical Duration** 1-2 hours	
Long Description	Aircrews detect radar signals from a simulated threat radar site and launch a High-Speed Anti-Radiation Missile (high-explosive) to destroy or disable the threat radar site. One or more fighter jets approach the threat radar site from high altitude. Once the target is located with onboard sensors, the aircrew launches a High-Speed Anti-Radiation Missile at the electronic signal. At-sea exercises involve training against a target vessel or a specially configured target barge that has a tower with an electronic emitter that the missile will seek after being fired from the launch aircraft.		
Typical Components	**Platforms:** Fixed-wing aircraft, support craft **Targets:** Barge with an electronic emitter **Systems being Trained/Tested:** Missile systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Chemicals other than explosives Metals	Other materials
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Missile (explosive) fragments, target fragments **Non-Ingestible Material:** Anchor- other	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		

Electronic Warfare		
High Speed Anti-Radiation Missile Exercise (Air-to-Surface)		
Procedural Mitigation Measures	**Explosive Stressors:** (*Section 5.3.3)* Explosive missiles and rockets	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	All chaff and flares involved in this exercise are covered under chaff exercises and flare exercises, respectively. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.	

A.2.7 Expeditionary Warfare

A.2.7.1 Dive and Salvage Operations

Expeditionary Warfare			
Dive and Salvage Operations			
Short Description	Navy divers perform dive operations and salvage training.	**Typical Duration** 12 hours	
Long Description	Navy divers will conduct a variety of salvage training to include debeaching operations, underwater repairs to ships, underwater survey operations, and other underwater training as required.		
Typical Components	**Platforms:** Support craft, unmanned underwater vehicles **Targets:** None **Systems being Trained/Tested:** Submersible training aids		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** Naval Station Norfolk, Virginia Lower Chesapeake Bay Naval Station Mayport James River and tributaries
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	The practice salvage platform can be sunk and then refloated and removed.		

A.2.7.2 Maritime Security Operations – Anti-Swimmer Grenades

<table>
<tr><th colspan="4">Expeditionary Warfare</th></tr>
<tr><th colspan="4">Maritime Security Operations – Anti-Swimmer Grenades</th></tr>
<tr><td>Short Description</td><td>Small boat crews engage in force protection activities by using anti-swimmer grenades to defend against hostile divers.</td><td colspan="2">Typical Duration
1 hour</td></tr>
<tr><td>Long Description</td><td colspan="3">Boat crews train to maneuver small boats in specific search patterns while surveying the area for evidence of scuba activity. Crews train in the safe handling and use of anti-swimmer grenades to counter the diver threat.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Small boats
Targets: None
Systems being Trained/Tested: Grenades</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Northeast
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Vessel noise
Weapons noise
Explosives:
In-water explosives
Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended material
Ingestion:
Military expended materials – munitions
Energy:
None
Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants
Sediments and Water Quality:
Explosives
Metals
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">Cultural Resources:
Physical disturbance and strike
Explosives
Socioeconomic Resources:
Accessibility
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Grenade fragments
Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">E2</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement
Explosive Stressors: (Section 5.3.3)
Maritime security operations – anti-swimmer grenades</td></tr>
</table>

Expeditionary Warfare	
Maritime Security Operations – Anti-Swimmer Grenades	
Assumptions Used for Analysis	Exercises would usually be conducted in established underwater detonation areas.

A.2.7.3 Personnel Insertion/Extraction – Air

Expeditionary Warfare		
Personnel Insertion/Extraction – Air		
Short Description	Personnel are inserted into and extracted from an objective area by fixed-wing aircraft or helicopters.	**Typical Duration** 2-4 hours
Long Description	Personnel are inserted into a water objective via fixed-wing aircraft using parachutes or by helicopters via ropes or jumping into the water. They will conduct an infiltration to an objective (harbor, beach, moored vessel, etc.) and conduct a variety of tasks. The insertion/extraction activities are confined to in-water training. Upon completion of training objectives, personnel are extracted by helicopters or small boats.	
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, small boats **Targets:** None **Systems being Trained/Tested:** None	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Key West Virginia Capes **Inshore Waters/Pierside:** Naval Station Mayport, Florida St. Andrew Bay North Bay Lower Chesapeake Bay James River and tributaries York River
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Chemicals other than explosives
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Marine markers	**Military Recoverable Material** None
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Expeditionary Warfare	
Personnel Insertion/Extraction – Air	
Assumptions Used for Analysis	Exercises are typically conducted in waters near land.

A.2.7.4 Personnel Insertion/Extraction – Surface and Subsurface

Expeditionary Warfare			
Personnel Insertion/Extraction – Surface and Subsurface			
Short Description	Personnel are inserted into and extracted from an objective area by small boats or subsurface platforms.	**Typical Duration**	2-4 hours
Long Description	Utilizing both small surface and subsurface platforms, personnel are inserted in the water. They will conduct an infiltration to an objective (harbor, beach, moored vessel, etc.) and conduct a variety of tasks. The insertion/extraction activities are confined to in-water training.		
Typical Components	**Platforms:** Small boats, manned underwater vehicles **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations**	
		Range Complexes/Testing Ranges: Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** Lower Chesapeake Bay James River and tributaries York River
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices Military expended material **Ingestion:** Military expended materials - munitions	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Physical disturbance and strike Airborne acoustics	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** Small caliber (casing only) **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Exercises are typically conducted in waters near land.		

A.2.7.5 Personnel Insertion/Extraction – Swimmer/Diver

Expeditionary Warfare			
Personnel Insertion/Extraction Training – Swimmer/Diver			
Short Description	Divers and swimmer infiltrate harbors, beaches, or moored vessels and conduct a variety of tasks.	**Typical Duration** Up to 12 hours	
Long Description	Divers and swimmer infiltrate harbors, beaches, or moored vessels and conduct a variety of tasks. Activity may include Navy personnel learning advanced self-contained underwater breathing apparatus (SCUBA) diving to include: tactics, techniques, and procedures and emergency procedures. Small boats are used for safety.		
Typical Components	**Platforms:** Small boats **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Key West Virginia Capes	**Inshore Waters/Pierside:** Lower Chesapeake Bay
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.2.7.6 Underwater Construction Team Training

Expeditionary Warfare			
Underwater Construction Team Training			
Short Description	Navy divers conduct underwater repair and construction.	**Typical Duration**	Up to 12 days
Long Description	Navy divers will perform cutting, welding, assembly, and installation of deep-water structures, mooring systems, underwater instrumentation, and other systems as needed.		
Typical Components	**Platforms:** Small boats **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico, Jacksonville, Key West, Virginia Capes **Inshore Waters/Pierside:** Various harbors	
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike; Seafloor devices **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility; Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Bottom placed instruments
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.2.8 MINE WARFARE

Mine warfare is the naval warfare area involving the detection, avoidance, and neutralization of mines to protect Navy ships and submarines and offensive mine laying in naval operations. A naval mine is a self-contained explosive device placed in water to destroy ships or submarines. Naval mines are deposited and left in place until triggered by the approach of an enemy ship or are destroyed or removed. Naval mines can be laid by purpose-built minelayers, other ships, submarines, or airplanes. Mine warfare training includes mine countermeasures exercises and mine-laying exercises.

A.2.8.1 Airborne Mine Countermeasure – Mine Detection

<table>
<tr><th colspan="4">Mine Warfare</th></tr>
<tr><th colspan="4">Airborne Mine Countermeasures – Mine Detection</th></tr>
<tr><td>Short Description</td><td colspan="2">Helicopter aircrews detect mines using towed or laser mine detection systems.</td><td>Typical Duration
2 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Helicopter aircrews use towed and airborne devices to detect, locate, and classify potential mines. Towed devices employ active acoustic sources, such as high-frequency and side scanning sonar. These devices are similar in function to systems used to map the seafloor or locate submerged structures/items. Airborne devices utilize laser systems to locate mines located below the surface. Devices used include the AN/AQS-20/A, towed mine-hunting sonar used to detect and classify bottom and floating/moored mines in deep and shallow water, and the Airborne Laser Mine Detection System, developed to detect and classify floating and near-surface, moored mines.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Rotary-wing aircraft
Targets: Mine shapes
Systems being Trained/Tested: Mine detection systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Aircraft safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Virginia Capes
Naval Surface Warfare Center, Panama City Division
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Sonar and other transducers
Aircraft noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Seafloor devices

Ingestion:
None</td><td>Energy:
In-water electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
None</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
</table>

Mine Warfare			
Airborne Mine Countermeasures – Mine Detection			
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	**High-Frequency:** HF4		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Towed in-water devices	
Assumptions Used for Analysis	Sonar mine detection systems towed from helicopters. Airborne laser systems used to detect mine shapes. Laser systems are similar to commercial Light Detection And Ranging (LIDAR) systems. The in-air energy stressor was used in analysis of potential impacts on human resources. Mine shapes may be deployed via ship and will be recovered.		

A.2.8.2 Airborne Mine Countermeasure – Towed Mine Neutralization

Mine Warfare		
Airborne Mine Countermeasures – Towed Mine Neutralization		
Short Description	Helicopter aircrews tow systems through the water that are designed to disable or trigger mines.	**Typical Duration** 1.5-4 hours
Long Description	Helicopter vehicle operators use towed devices to trigger mines that are designed to detonate when they detect ships/submarines by engine/propeller sounds or magnetic (steel construction) signature. Towed devices can also employ cable cutters to detach floating moored mines. Training may be conducted with non-explosive training mine shapes. Devices used include the following: MK 105 sled, which creates a magnetic field used to trigger mines and can be used in conjunction with the MK 103 cable cutter system and the MK 104 acoustic countermeasure, and AN/SPU-1/W (Magnetic Orange Pipe), a magnetic pipe that is used to trigger magnetically influenced mines.	
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Mine shapes **Systems being Trained/Tested:** Towed mine neutralization systems	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico, Jacksonville, Navy Cherry Point, Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike; Vessel and in-water device strike; Seafloor devices **Ingestion:** None **Energy:** In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility; Physical disturbance and strike **Public Health and Safety:** Physical interactions; In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material:** Mine shapes (non-explosive)
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	

Mine Warfare	
Airborne Mine Countermeasures – Towed Mine Neutralization	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Towed in-water devices
Assumptions Used for Analysis	Mechanical sweeping (cable cutting), acoustic and magnetic influence sweeping devices are towed from helicopters. Cable cutters utilize an insignificant charge (similar to a shotgun shell). Acoustic sweeps generate ship-type noise via a mechanical system. Towing systems though minefields (or without mines, to train to deploy, tow, and recover) may involve instrumented mines. Mine shapes are recovered.

A.2.8.3 Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercise

Mine Warfare			
Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises			
Short Description	Maritime security personnel train to protect civilian ports and harbors against enemy efforts to interfere with access to those ports.	**Typical Duration**	Multiple days
Long Description	Naval forces provide mine warfare capabilities to support Department of Homeland Security sponsored exercises. The three pillars of mine warfare, airborne (helicopter), surface (surface ships), and undersea (divers, marine mammals, and unmanned vehicles) mine countermeasures will be brought to bear in order to ensure strategic U.S. ports remain free of mine threats. Various mine warfare sensors, which utilize active acoustics, will be employed in the detection, classification, and neutralization of mines. Along with traditional mine warfare techniques, such as helicopter towed mine countermeasures, new technologies (unmanned vehicles) will be utilized. Marine mammal systems may be used during this exercise. Exercise locations and scenarios will vary according to Department of Homeland Security strategic goals and evolving world events.		
Typical Components	**Platforms:** Moored platforms, rotary-wing aircraft, support craft, surface combatants, unmanned underwater vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** Mine detection systems, towed mine neutralization systems, airborne mine neutralization systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** Beaumont, Texas Boston, Massachusetts Corpus Christi, Texas Delaware Bay, Delaware Earle, New Jersey Hampton Roads, Virginia Kings Bay, Georgia Morehead City, North Carolina Naval Station Mayport, Florida Port Canaveral, Florida Savannah, Georgia Tampa, Florida Wilmington, North Carolina
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise Weapons noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Seafloor devices Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-water electromagnetic devices **Entanglement:** Wires and cables

<table>
<tr><th colspan="3">Mine Warfare</th></tr>
<tr><th colspan="3">Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercises</th></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Metals
Explosives and explosive byproducts
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="2">Cultural Resources:
Physical disturbance and strike
Explosives

Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike

Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Mine neutralizer fragments

Non-Ingestible Material:
Fiber optic cable, fiber optic can</td><td>Military Recoverable Material
Mine shapes (non-explosive)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="2">High-Frequency:
HF4

Synthetic Aperture Sonars:
SAS2</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="2">E2
E4</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="2">Acoustic Stressors: (Section 5.3.2)
Active sonar

Explosive Stressors: (Section 5.3.3)
Explosive mine neutralization activities involving Navy divers

Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement
Towed in-water devices</td></tr>
<tr><td>Assumptions Used for Analysis</td><td colspan="2">Non-permanent mine shapes will be laid in various places on the bottom and will be retrieved.
Shapes are varied, from about 1 m circular to about 2.5 m long by 1 m wide. They will be recovered using normal assets, with diver involvement.
Explosives may be used if required for scheduled mine neutralization exercises.
While goal is to conduct once per year, alternating east/west coast, assume that an east coast exercise will occur every other year with a total of three per five year period.</td></tr>
</table>

A.2.8.4 Coordinated Unit-Level Helicopter Airborne Mine Countermeasures Exercise

Mine Warfare			
Coordinated Unit-Level Helicopter Airborne Mine Countermeasures Exercise			
Short Description	A detachment of helicopters aircrews train as a unit in the use of airborne mine countermeasures, such as towed mine detection and neutralization systems.	**Typical Duration** Multiple days	
Long Description	Naval aircrews train, as a squadron, in the use of various airborne mine countermeasures. Systems employed include towed mine detection systems, mechanical (cable cutting) mine sweeps, magnetic and acoustic mine sweeps, and other airborne systems and sensors. Mine shapes will be used. If necessary, permanently placed mine shapes will be supplemented with approximately 24 additional, temporarily placed mine shapes. Training mine shapes could be bottom placed, moored, or floating.		
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Mine shapes **Systems being Trained/Tested:** Mine detection systems, towed mine neutralization systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Military expended materials Aircraft and aerial target strike Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Mine shapes (non-explosive)	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	**High-Frequency:** HF4		
In-Water Explosive Bins	None		

Mine Warfare		
Coordinated Unit-Level Helicopter Airborne Mine Countermeasures Exercise		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	Multiple helicopters conduct airborne mine countermeasure training using an assortment of mine warfare gear similar to unit-level events, except that a squadron trains together. Assume up to 24 temporary mine shapes will be deployed to support each of these exercises.	

A.2.8.5 Mine Countermeasures – Ship Sonar

Mine Warfare			
Mine Countermeasure – Ship Sonar			
Short Description	Ship crews detect and avoid mines while navigating restricted areas or channels using active sonar.	**Typical Duration**	1.5-4 hours
Long Description	Surface ship crews detect and avoid mines or other underwater hazardous objects while navigating restricted areas or channels using active sonar. A Littoral Combat Ship utilizes unmanned surface vehicles and remotely operated vehicles to tow mine detection (hunting) equipment. Systems will operate from a shallow zone greater than 40 ft. to deep water. Exercises could be embedded within major training exercises.		
Typical Components	**Platforms:** Surface combatants, unmanned surface vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Physical disturbance and strike Airborne acoustics	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	**High-Frequency:** HF4		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	

Mine Warfare	
Mine Countermeasure – Ship Sonar	
Assumptions Used for Analysis	No explosives are used. It is assumed that the system will be operated in areas free of obstructions and will be towed well above the seafloor. Towed systems are always operated in a manner to avoid entanglement and damage. Exercises take place in water depths of 40 ft. and greater. Existing placed mine shapes to be used. There is the potential for temporary placement of mine shapes.

A.2.8.6 Mine Countermeasures – Mine Neutralization – Remotely Operated Vehicle

<table>
<tr><th colspan="4">Mine Warfare</th></tr>
<tr><th colspan="4">Mine Countermeasures – Mine Neutralization – Remotely Operated Vehicles</th></tr>
<tr><td>Short Description</td><td colspan="2">Ship, small boat, and helicopter crews locate and disable mines using remotely operated underwater vehicles.</td><td>Typical Duration
1.5-4 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Ship, small boat, and helicopter crews utilize remotely operated vehicles to neutralize potential mines. Remotely operated vehicles will use sonar and optical systems to locate and target mine shapes. Explosive mine neutralizers may be used during live fire events.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Rotary-wing aircraft, small boats, surface combatants
Targets: Mine shapes
Systems being Trained/Tested: Airborne mine neutralization systems, in-water explosives</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Vessel noise
Sonar and other transducers

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended material
Seafloor devices

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices
In-water electromagnetic devices

Entanglement:
Wires and cables</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Explosives and explosive byproducts
Metals
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike
Explosives</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Mine neutralizer fragments

Non-Ingestible Material:
Fiber optic cables, fiber optic cans</td><td>Military Recoverable Material</td><td>Mine shapes (non-explosive)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">High-Frequency:
HF4</td></tr>
</table>

Mine Warfare		
Mine Countermeasures – Mine Neutralization – Remotely Operated Vehicles		
In-Water Explosive Bins	E4	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	**Explosive Stressors:** *(Section 5.3.3)* Explosive mine countermeasure and neutralization activities
Assumptions Used for Analysis	None	

A.2.8.7 Mine Laying

Mine Warfare			
Mine Laying			
Short Description	Fixed-wing aircraft drop non-explosive mine shapes.	**Typical Duration**	1 hour
Long Description	Fixed-wing aircraft lay offensive or defensive mines for a tactical advantage for friendly forces. Fixed-wing aircraft lay a precise minefield pattern for specific tactical situations. The aircrew typically makes multiple passes in the same flight pattern, and drop one or more training shapes per pass (four shapes total). Training shapes are non-explosive.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended materials Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** None	**Public Health and Safety:** None
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Mine shapes (non-explosive)	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive bombs and mine shapes		

Mine Warfare	
Mine Laying	
Assumptions Used for Analysis	Mine laying is similar to non-explosive bombing exercises. These exercises primarily occur during major training exercises. Mine laying will typically take place in waters less than 100 ft. in depth. Assume 12 mine shapes are used per exercise. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.8.8 Mine Neutralization – Explosive Ordnance Disposal

Mine Warfare		
Mine Neutralization Explosive Ordnance Disposal		
Short Description	Personnel place limpet mines or disable threat mines using explosive charges.	**Typical Duration** Up to 8 hours
Long Description	Navy divers, typically explosive ordnance disposal personnel, disable threat mines with explosive charges to create a safe channel for friendly vessels to transit or placing or detonating limpet mines on steel structures. Personnel detect, identify, evaluate, and neutralize mines in the water with an explosive device and may involve detonation of one or more explosive charges from 4 to 60 pounds of TNT equivalent. These operations are normally conducted during daylight hours for safety reasons. Time-delay fuses may be used for these exercises. Personnel also identify and place limpet mine charges on a steel structure in the water and detonate an explosive charge of up to 2.2 pounds of TNT equivalent. These operations are normally conducted during daylight hours for safety reasons.	
Typical Components	**Platforms:** Small boats **Targets:** Mine shapes, sub-surface I-beam demolition structure **Systems being Trained/Tested:** In-water explosives	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Virginia Capes **Inshore Waters/Pierside:** Lower Chesapeake Bay Truman Harbor Demolition Key
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** In-water explosives **Physical Disturbance and Strike:** Vessel and in-water device strike Military expended materials Seafloor devices **Ingestion:** Military expended materials – other than munitions	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Metals Chemicals other than explosives Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** Mine shape (explosive) fragments **Non-Ingestible Material:** None	**Military Recoverable Material** Mine shapes (non-explosive), metal plates, sub-surface I-beam demolition structure
Sonar and Other Transducer Bins	None	

Mine Warfare	
Mine Neutralization Explosive Ordnance Disposal	
In-Water Explosive Bins	E3 E4 E5 E6 E7
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement **Explosive Stressors: (Section 5.3.3)** Explosive mine neutralization activities involving Navy divers
Assumptions Used for Analysis	Time-delayed fuses may be used (up to 10 minutes) for charges up to 29 lb. net explosive weight in some locations. Charge placed anywhere in water column, including bottom. For limpet mines, the detonation is enclosed by steel on the four sides and concrete on the bottom. Almost all acoustic energy will be vented to the air. Some mine shapes and all of the sub-surface I-beam demolition structures will be recovered.

A.2.8.9 Underwater Mine Countermeasure Raise, Tow, Beach and Exploitation Operations

Mine Warfare			
Underwater Mine Countermeasure Raise, Tow, Beach and Exploitation Operations			
Short Description	Personnel locate mines, perform mine neutralization, raise and tow mines to the beach, and conduct exploitation operations for intelligence gathering.	**Typical Duration**	Up to 4 hours
Long Description	Navy divers, typically explosive ordnance disposal personnel, locate mines using unmanned underwater vehicle, marine mammals, or other diver search techniques. Mines are then neutralized, or prevented from working as they are intended. Explosive ordnance disposal personnel ensure the neutralization measures are effective and the shapes are safe to bring to the beach. A lift balloon is attached to the line and slowly tows the shape to the beach. The final step, exploitation, is intelligence gathering, identifying the mine and how it works, and then disassembling it or disposing of it.		
Typical Components	**Platforms:** Small boats **Targets:** Mine shapes **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** James River and tributaries Lower Chesapeake Bay York River Naval Submarine Base Kings Bay
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	None		

Mine Warfare	
Underwater Mine Countermeasure Raise, Tow, Beach and Exploitation Operations	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Exercises primarily conducted in W-50 in Virginia Capes Range Complex and beaches at Dam Neck Annex. Mine shapes are recovered as part of the exercise.

A.2.9 Surface Warfare Training

Surface warfare is a type of naval warfare in which aircraft, surface ships, and submarines employ weapons and sensors in operations directed against enemy surface ships or small boats. Aircraft-to-surface warfare is conducted by long-range attacks using air-launched cruise missiles, precision-guided munitions, or aircraft cannon. Surface warfare also is conducted by warships employing torpedoes, naval guns, and surface-to-surface missiles. Submarines attack surface ships using torpedoes or submarine-launched, anti-ship cruise missiles. Training in surface warfare includes surface-to-surface gunnery and missile exercises, air-to-surface gunnery and missile exercises, and submarine missile or torpedo launch events. Gunnery and missile training generally involves expenditure of ordnance against a towed target. A sinking exercise is a specialized training exercise that provides an opportunity for ship, submarine, and aircraft crews to use multiple weapons systems to deliver high-explosive ordnance on a deactivated vessel, which is deliberately sunk.

Surface warfare also encompasses maritime security, that is, the interception of a suspect surface ship by a Navy ship for the purpose of boarding-party inspection or the seizure of the suspect ship. Training in these tasks is conducted in visit, board, search and seizure exercises.

A.2.9.1 Bombing Exercise Air-to-Surface

Surface Warfare			
Bombing Exercise Air-to-Surface			
Short Description	Fixed-wing aircrews deliver bombs against surface targets.	**Typical Duration** 1 hour	
Long Description	Fixed-wing aircraft conduct bombing exercises against stationary floating targets (e.g., MK-58 smoke buoy), towed targets, or maneuvering targets. An aircraft clears the area, deploys a smoke buoy, and then delivers high-explosive or non-explosive practice bombs on the target. A range boat may be used to deploy towed or maneuvering targets for an aircraft to attack. Exercises for strike fighters typically involve a flight of two aircraft delivering unguided or guided munitions that may be either high-explosive or non-explosive. The following munitions may be employed by strike fighter aircraft in the course of bombing exercise: Unguided munitions including non-explosive subscale bombs (MK-76 and BDU-45), explosive and non-explosive general purpose bombs (MK-80 series), and MK-20 cluster bombs (explosive, non-explosive). Precision-guided munitions include laser-guided bombs (explosive, non-explosive), laser-guided training rounds (non-explosive), Joint Direct Attack Munitions (explosive, non-explosive).		
Typical Components	**Platforms:** Fixed-wing aircraft, support craft **Targets:** Surface targets **Systems being Trained/Tested:** Bombs, non-explosive practice munitions, aircraft platforms		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations**	
		Range Complexes/Testing Ranges: Gulf of Mexico Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None

Surface Warfare				
Bombing Exercise Air-to-Surface				
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** In-water explosives In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended materials **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None	
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Other materials	Metals	
Stressors to Human Resources	None			
Military Expended Material	**Ingestible Material:** Surface targets (mobile and stationary) fragments, bomb (explosive) fragments **Non-Ingestible Material:** Marine markers, bombs (non-explosive)	**Military Recoverable Material**	Surface targets (mobile)	
Sonar and Other Transducer Bins	None			
In-Water Explosive Bins	E9	E10	E12	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Non-explosive bombs and mine shapes	**Explosive Stressors:** *(Section 5.3.3)* Explosive bombs		
Assumptions Used for Analysis	Approximately 90 percent of non-explosive bombs are the sub-scale bombs such as the MK-76 and BDU-48. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.			

A.2.9.2 Fast Attack Craft and Fast Inshore Attack Craft

Surface Warfare			
Fast Attack Craft and Fast Inshore Attack Craft			
Short Description	Navy ships and helicopters defend against small boat attacks.	**Typical Duration**	2-4 hour
Long Description	Navy ships and helicopters detect, coordinate, and defend against multiple high speed small boats employing swarm tactics. Ships must coordinate defenses to achieve proper targeting of attack craft. Only blank ordnance is used in this activity. Activities conducted in the open ocean are called Fast Attack Craft, while those in littoral waters are called Fast Inshore Attack Craft.		
Typical Components	**Platforms:** Amphibious warfare ships, surface combatants, rotary-wing aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** Naval Station Mayport, Florida
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** Small-caliber projectiles (casings only) **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions		

Surface Warfare	
Fast Attack Craft and Fast Inshore Attack Craft	
Assumptions Used for Analysis	None

A.2.9.3 Gunnery Exercise Air-to-Surface Medium-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Air-to-Surface Medium-Caliber</th></tr>
<tr><td>Short Description</td><td colspan="2">Fixed-wing and helicopter aircrews fire medium-caliber guns at surface targets.</td><td>Typical Duration
1 hour</td></tr>
<tr><td>Long Description</td><td colspan="3">Fighter and helicopter aircrews engage surface targets with medium-caliber guns. Targets simulate enemy ships, boats, swimmers, and floating/near- surface mines. Fighter aircraft descend on a target firing high-explosive or non-explosive practice munitions medium-caliber projectiles. Helicopters will fly a racetrack pattern around an at-sea target. Aircrew will engage the target with medium-caliber weapons. Targets range from a smoke float, or an empty steel drum, to high speed remote controlled boats and jet-skis.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Fixed-wing aircraft, rotary-wing aircraft
Targets: Surface targets (e.g., MK 58 marine markers, empty steel drums, high speed remote controlled boats and jet-skis)
Systems being Trained/Tested: Medium-caliber gun systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Weapons firing safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Vessel noise
Weapons noise

Explosives:
De minimis explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended materials

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic energy

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediment and Water Quality:
Metals
Other materials
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Medium-caliber projectiles (non-explosive), medium-caliber casings, surface target (stationary) fragments

Non-Ingestible Material:
Marine markers</td><td>Military Recoverable Material</td><td>Surface targets (mobile)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
</table>

Surface Warfare	
Gunnery Exercise Air-to-Surface Medium-Caliber	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions **Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles
Assumptions Used for Analysis	Most medium-caliber air-to-surface gunnery exercises will be with non-explosive training projectiles. High-explosive rounds will supplement when non-explosive training projectiles are not available. Fixed-wing projectile casings remain with aircraft and rotary-wing projectile casings are expended into the water. Two fixed-wing aircraft (400 rounds each) or one helicopter (400 rounds) per activity. One target used per exercise; expendable smoke floats (50 percent), stationary targets (45 percent), or remote-controlled targets (5 percent). De minimis explosives used during this activity are not quantitatively analyzed and, therefore, not included under munitions. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.9.4 Gunnery Exercise Air-to-Surface Small-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Air-to-Surface Small-Caliber</th></tr>
<tr><td>Short Description</td><td colspan="2">Helicopter and tiltrotor aircrews, use small-caliber guns to engage surface targets.</td><td>Typical Duration
1 hour</td></tr>
<tr><td>Long Description</td><td colspan="3">Helicopters and tiltrotor aircraft, fly a racetrack pattern around an at-sea target. Targets simulate enemy ships, boats, and floating/near-surface mines. Each gunner will engage the target with small-caliber weapons. Targets range from a smoke float, an empty steel drum, to high speed remote controlled boats and jet-skis.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Rotary-wing aircraft, tiltrotor aircraft
Targets: Surface targets (e.g., MK 58 marine markers, empty steel drums, high speed remote controlled boats and jet-skis
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Weapons firing safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Navy Cherry Point
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Aircraft noise
Vessel noise
Weapons noise
Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended material
Energy:
In-air electromagnetic devices

Explosives:
None
Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions
Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants
Sediments and Water Quality:
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">Cultural Resources:
Physical disturbance and strike
Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-air energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Small-caliber projectiles (non-explosive), small-caliber casings, surface target (stationary) fragments

Non-Ingestible Material:
Marine markers</td><td>Military Recoverable Material</td><td>Surface targets (mobile)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">None</td></tr>
</table>

Surface Warfare	
Gunnery Exercise Air-to-Surface Small-Caliber	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions
Assumptions Used for Analysis	Most exercises will occur proximate to naval stations where MH-60 helicopters are home based and target services are available.

A.2.9.5 Gunnery Exercise Surface-to-Surface Boat Medium-Caliber

Surface Warfare			
Gunnery Exercise Surface-to-Surface Boat Medium-Caliber			
Short Description	Small boat crews fire medium-caliber guns at surface targets.	**Typical Duration** 1 hour	
Long Description	Small boat crews fire medium-caliber guns at surface targets. Boat crews may use high or low speeds to approach and engage targets simulating other boats, floating mines, or nearshore land targets with medium-caliber (up to and including 40 mm) weapons. A commonly used target is an empty steel drum. A number of different types of boats are used depending on the unit using the boat and their mission. Boats are most used to protect ships in harbors and high value units, such as: aircraft carriers, nuclear submarines, liquid natural gas tankers, etc., while entering and leaving ports, as well as to conduct riverine operations and various naval special warfare operations. The boats used by these units include small unit river craft, combat rubber raiding craft, rigid-hull inflatable boats, patrol craft, and many other versions of these types of boats. These boats use inboard or outboard diesel or gasoline engines with either propeller or water jet propulsion.		
Typical Components	**Platforms:** Small boats **Targets:** Surface targets (e.g., empty steel drums) **Systems being Trained/Tested:** Medium-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended material – munitions Military expended material – other than munitions	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Metals Chemicals other than explosives Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy

Surface Warfare			
Gunnery Exercise Surface-to-Surface Boat Medium-Caliber			
Military Expended Material	**Ingestible Material:** Medium-caliber projectile (explosive) fragments, medium-caliber casings, surface target (stationary) fragments **Non-Ingestible Material:** Surface targets (stationary)	**Military Recoverable Material**	Surface target (mobile)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E1		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions	**Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles	
Assumptions Used for Analysis	Approximately 500 rounds expended per exercise. One target used per exercise, typically a stationary target such as a 50-liter steel drum.		

A.2.9.6 Gunnery Exercise Surface-to-Surface Boat Small-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Surface-to-Surface Boat Small-Caliber</th></tr>
<tr><td>Short Description</td><td colspan="2">Small boat crews fire small-caliber guns at surface targets.</td><td>Typical Duration
1 hour</td></tr>
<tr><td>Long Description</td><td colspan="3">Small boat crews fire small-caliber guns at surface targets. Boat crews may use high or low speeds to approach and engage targets simulating other boats, swimmers, floating mines, or nearshore land targets with small-caliber (up to and including 0.50 caliber) weapons. A commonly used target is an empty steel drum.

A number of different types of boats are used depending on the unit using the boat and their mission. Boats are most used to protect ships in harbors and high value units, such as: aircraft carriers, nuclear submarines, liquid natural gas tankers, etc., while entering and leaving ports, as well as to conduct riverine operations, and various naval special warfare operations. The boats used by these units include: small unit river craft, combat rubber raiding craft, rigid-hull inflatable boats, patrol craft, and many other versions of these types of boats. These boats use inboard or outboard, diesel or gasoline engines with either propeller or water jet propulsion.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Small boats
Targets: Surface targets (e.g., empty steel drums)
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Weapons firing safety</td><td colspan="2">Typical Locations

Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Northeast
Virginia Capes

Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise
Weapons noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
None

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Small-caliber (non-explosive) projectiles, small-caliber casings

Non-Ingestible Material:
Surface target (stationary)</td><td>Military Recoverable Material</td><td>Surface target (mobile)</td></tr>
</table>

Surface Warfare	
Gunnery Exercise Surface-to-Surface Boat Small-Caliber	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions
Assumptions Used for Analysis	The majority of exercises will occur proximate to naval stations. Exercises will occur relatively nearshore due to short range of boats and safety concerns. Exercises mostly occur within 3 NM of the shoreline, but can occur further from shore.

A.2.9.7 Gunnery Exercise Surface-to-Surface Ship Large-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Surface-to-Surface Ship – Large-Caliber</th></tr>
<tr><td rowspan="2">Short Description</td><td rowspan="2" colspan="2">Surface ship crews fire large-caliber guns at surface targets.</td><td>Typical Duration</td></tr>
<tr><td>Up to 3 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">This exercise involves ships' gun crews engaging surface targets at sea with their main battery large-caliber (typically 57 mm and 5-inch) guns. Targets include the QST-35 seaborne powered target, high speed maneuverable surface target, or a specially configured remote controlled watercraft. Some targets are expended during the exercise and are not recovered.

The exercise proceeds with the target boat approaching from about 10-NM distance. The target is tracked by radar and when within a predetermined range, it is engaged first with large-caliber "warning shots." As threats get closer all weapons may be used to disable the threat.

This exercise may involve a single firing ship, or be undertaken in the context of a coordinated larger exercise involving multiple ships, including a major training exercise.

Large-caliber guns will also be fired during weapon certification events and in conjunction with weapon maintenance.

During all exercises, either high-explosive or non-explosive rounds may be used. High-explosive rounds can either be fused for detonation on impact (with water surface or targets), or for proximity to the target (in air detonation).</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Surface combatants
Targets: Surface targets (e.g., QST-35 seaborne powered targets, high speed maneuverable surface targets, or specially configured remote controlled water craft)
Systems being Trained/Tested: Large-caliber gun systems</td></tr>
<tr><td rowspan="2">Standard Operating Procedures
(Section 2.3.3)</td><td rowspan="2">Vessel safety
Weapons firing safety</td><td colspan="2">Typical Locations</td></tr>
<tr><td>Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Virginia Capes
Other AFTT Areas</td><td>Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise
Weapons noise

Explosives:
In-water explosives
In-air explosives</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended materials

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices
In-water electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants</td><td>Sediments and Water Quality:
Explosives and explosive byproducts
Metals
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
</table>

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Surface-to-Surface Ship – Large-Caliber</th></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Surface target (stationary)fragments, large-caliber projectile (explosive) fragments

Non-Ingestible Material:
Large-caliber projectiles (non-explosive), large-caliber casings, kinetic energy round, sabot- kinetic energy round</td><td>Military Recoverable Material</td><td>Surface target (mobile)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">E3 E5</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Acoustic Stressors: (Section 5.3.2)
Weapons firing noise

Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement
Small-, medium-, and large-caliber non-explosive practice munitions

Explosive Stressors: (Section 5.3.3)
Explosive medium-caliber and large-caliber projectiles</td></tr>
<tr><td>Assumptions Used for Analysis</td><td colspan="3">For analytical purposes assume all high-explosive rounds are fused to detonate upon impact with the water surface or target.
After impacting the water, the high-explosive rounds are expected to detonate within 33 ft. of the surface. Non-explosive rounds, and fragments from the high-explosive rounds will sink to the bottom of the ocean.
Assume each non-explosive projectile will be up to 5 in. in diameter and 30 in. in length, and each firing will also expend a metallic sleeve used to convey the projectile down the gun barrel.
Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.</td></tr>
</table>

A.2.9.8 Gunnery Exercise Surface-to-Surface Ship Medium-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Surface-to-Surface Ship Medium-Caliber</th></tr>
<tr><td>Short Description</td><td colspan="2">Surface ship crews fire medium-caliber guns at surface targets.</td><td>Typical Duration
2-3 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Surface ship crews fire medium-caliber guns at surface targets.

Ships use medium-caliber weapons to practice defensive marksmanship, typically against a stationary floating target (a 10 ft. diameter red balloon [Killer Tomato]) and high-speed mobile targets. Some targets are expended during the exercise and are not recovered.

Shipboard protection systems (Close-In Weapon System) utilizing medium-caliber projectiles would train against high speed mobile targets.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Patrol combatants, surface combatants
Targets: Surface targets (e.g., stationary floating targets, high-speed mobile targets)
Systems being Trained/Tested: Medium-caliber gun systems</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Weapons firing safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Virginia Capes
Navy Cherry Point
Jacksonville
Gulf of Mexico
Other AFTT Areas
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise
Weapons noise

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Explosives and explosive byproducts
Metals
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Explosives
Physical disturbance and strike</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Surface target (stationary) fragments, medium-caliber projectile (explosive) fragments, medium-caliber casings

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>Surface targets (mobile)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
</table>

Surface Warfare	
Gunnery Exercise Surface-to-Surface Ship Medium-Caliber	
In-Water Explosive Bins	E1
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Large-caliber weapons firing **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement **Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles
Assumptions Used for Analysis	One target used per exercise. Approximately 50 percent of targets are “Killer Tomatoes” (usually recovered). Approximately 35 percent are high-speed maneuvering targets, which are recovered. Approximately 15 percent of targets are other stationary targets such as a steel drum that are not recovered. Number or rounds per exercise varies depending on munitions used.

A.2.9.9 Gunnery Exercise Surface-to-Surface Ship Small-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gunnery Exercise Surface-to-Surface Ship Small-Caliber</th></tr>
<tr><td>Short Description</td><td colspan="2">Surface ship crews fire small-caliber guns at surface targets.</td><td>Typical Duration
2-3 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Surface ship crews fire small-caliber guns at surface targets.

Ships use small-caliber weapons to practice defensive marksmanship, typically against stationary floating targets. The target may be a 10 ft. diameter red balloon (Killer Tomato, see Figure A.2-4), a 50 gallon steel drum, or other available target, such as a cardboard box. Some targets are expended during the exercise and are not recovered.

Ship crew qualifications conducted at sea employ stationary targets on deck. Small-caliber projectiles fired during these exercises will be expended in the water.

Shipboard protection systems utilizing small-caliber projectiles will train against high speed mobile targets.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Navy ships
Targets: Surface targets (e.g., Killer Tomatoes, 50-gallon steel drums, cardboard boxes)
Systems being Trained/Tested: Small-caliber gun systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Weapons firing safety</td><td colspan="2">Typical Locations

Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Virginia Capes
Other AFTT Areas

Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise
Weapons noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended materials

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices
In-water electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Small-caliber projectiles (non-explosive), small-caliber casings, surface target (stationary) fragments

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>Surface target (mobile)</td></tr>
</table>

Surface Warfare	
Gunnery Exercise Surface-to-Surface Ship Small-Caliber	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions
Assumptions Used for Analysis	Small-caliber gun rounds per exercise: 1,000 to 3,000 non-explosive practice munitions. The majority of the activities will occur proximate to Navy homeports in Jacksonville, Florida and Norfolk, Virginia.

Figure A.2-4: "Killer Tomato" Stationary Floating Target

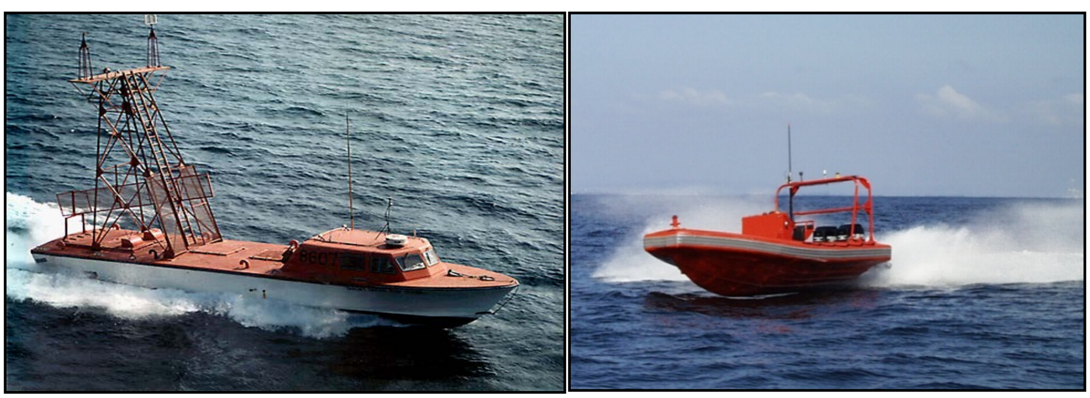


Figure A.2-5: QST-35 Seaborne Powered Target (on Left) and High-Speed Maneuvering Surface Target (on Right)

A.2.9.10 Integrated Live Fire

Surface Warfare		
Integrated Live Fire		
Short Description	Naval forces defend against a swarm of surface threats (ships or small boats) with bombs, missiles, rockets, and small-, medium- and large-caliber guns.	**Typical Duration** 6-8 hours
Long Description	Naval forces use coordinated tactics and deliver high-explosive ordnance against a swarm of surface maritime threats. Events within this activity include: exercises for strike fighters typically involve a flight of two to four aircraft delivering unguided or guided munitions that may be either high-explosive or non-explosive bombs against surface targets. The bombs may be surface detonating or designed to detonate as an air-burst bomb; strike fighter aircraft, helicopter aircrews, and ship crews fire high-explosive precision-guided missiles against surface targets. If explosive, helicopter launched missiles (including rockets) typically detonate at or just below the water's surface; fighter and helicopter aircrew engage surface targets with small- and medium-caliber guns. Ships' gun crews engage surface targets with large-caliber (typically 57 mm and 5-inch) guns; this exercise may involve a single firing ship or be undertaken in the context of a coordinated larger exercise involving multiple ships, including a major training exercise.	
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, surface combatants, support craft **Targets:** Surface targets (e.g., remote controlled surface targets, towed surface targets) **Systems being Trained/Tested:** In-air low energy laser, medium- and large-caliber gun systems, aircraft platforms	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville, Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** In-water explosives In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Metals Chemicals other than explosives Other materials
Stressors to Human Resources	None	

Surface Warfare			
Integrated Live Fire			
Military Expended Material	**Ingestible Material:** Bomb (explosive) fragments, missile (explosive) fragments, medium-caliber projectiles (non-explosive), medium-caliber and large-caliber projectile (explosive) fragments, medium-caliber casings, rocket (explosive) fragments, surface target (stationary and mobile) fragments **Non-Ingestible Material:** Bombs (non-explosive), , large-caliber casings	**Military Recoverable Material**	Surface targets (mobile)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E1 E3 E6 E10		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions Non-explosive missiles and rockets Non-explosive bombs	**Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles Explosive missiles and rockets Explosive bombs	
Assumptions Used for Analysis	Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

A.2.9.11 Laser Targeting – Aircraft

Surface Warfare	
Laser Targeting – Aircraft	
Short Description	Fixed-wing and helicopter aircrews illuminate enemy targets with lasers. **Typical Duration:** 1-2 hours
Long Description	Fixed-wing and helicopter aircrew illuminate enemy targets with lasers for engagement by aircraft with laser guided bombs or missiles. This exercise may be conducted alone or in conjunction with other exercises utilizing precision guided munitions, such as surface missiles and guided rockets. Exercises where weapons are fired are addressed in the appropriate activity (e.g., air-to-surface missile exercise). Lower powered lasers may also be used as non-lethal deterrents during maritime security operations (force protection).
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, unmanned aerial systems **Targets:** Surface targets **Systems being Trained/Tested:** Aircraft platforms
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety **Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville; Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise; Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike; Vessel and in-water device **Ingestion:** Military expended materials – other than munitions **Energy:** In-air electromagnetic devices; In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediments and Water Quality:** Metals; Other materials
Stressors to Human Resources	None
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None **Military Recoverable Material:** Surface target (mobile)
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Laser targeting for missile/rocket guidance will occur in areas where these exercises also occur. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.9.12 Laser Targeting – Ship

Surface Warfare			
Laser Targeting – Ship			
Short Description	Surface ship crews illuminate air and surface targets with high-energy laser systems.	**Typical Duration**	1-2 hours
Long Description	Ship crews employ high-power energy laser systems that are used to create critical failures in airborne and surface targets. System directs a directed energy beam that can penetrate thin layers of metal at short distances (less than 1 nautical mile) that can render air and surface targets inoperative. Laser systems can also be used in a low power setting as non-lethal deterrent during maritime security operations (force protection). The low power capability would not be used against manned platforms during training.		
Typical Components	**Platforms:** Aircraft carriers, amphibious warfare ships, combat logistics, specialized high-speed vehicles, support craft, surface combatants **Targets:** Air targets, surface targets **Systems being Trained/Tested:** Laser weapon system		
Standard Operating Procedures *(Section 2.3.3)*	High-powered laser safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Military expended material Vessel and in-water device strike Aircraft and aerial target strike **Ingestion:** Military expended materials – other than munitions	**Energy:** High-energy lasers In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Air target (drone) fragments **Non-Ingestible Material:** None	**Military Recoverable Material**	Surface target (mobile)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Laser targeting for missile/rocket guidance will occur in areas where these exercises also occur. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

A.2.9.13 Maritime Security Operations

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Maritime Security Operations</th></tr>
<tr><td>Short Description</td><td colspan="2">Helicopter, surface ship, and small boat crews conduct a suite of maritime security operations at sea, to include visit, board, search and seizure; maritime interdiction operations; force protection; and anti-piracy operations.</td><td>Typical Duration
Up to 3 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Helicopter and surface ship crews conduct a suite of maritime security operations (e.g., visit, board, search and seizure, maritime interdiction operations, force protection, and anti-piracy operations). These activities involve training of boarding parties delivered by helicopters and surface ships to surface vessels for the purpose of simulating vessel search and seizure operations. Various training scenarios are employed and may include small arms with non-explosive blanks and surveillance or reconnaissance unmanned surface and aerial vehicles. The entire exercise may last two to three hours.

Vessel Visit, Board, Search, and Seizure: Military personnel from ships and aircraft board suspect vessels, potentially under hostile conditions.

Maritime Interdiction Operations: Ships and aircraft train in pursuing, intercepting, and ultimately detaining suspect vessels.

Maritime Infrastructure Protection and Harbor Defense: Naval personnel train to defend oil platforms, similar at sea structures, harbors, piers, and other infrastructure.

Warning Shot/Disabling Fire: Naval personnel train in the use of weapons to force fleeing or threatening small boats (typically operating at high speeds) to come to a stop.

Ship Force Protection: Ship crews train in tracking multiple approaching, circling small craft, assessing threat potential, and communicating amongst crewmates and other vessels to ensure ships are protected against attack.

Anti-Piracy Training: Naval personnel train in deterring and interrupting piracy activity. Training includes large vessels (pirate “mother ships”), and multiple small, maneuverable, and fast craft.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Amphibious warfare ships, rotary-wing aircraft, surface combatants, small boats
Targets: Surface targets
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Aircraft safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Northeast
Virginia Capes

Inshore Waters/Pierside:
James River and tributaries
Lower Chesapeake Bay
Naval Station Norfolk, Virginia
Naval Station Mayport, Florida
Narragansett Bay, Rhode Island
Port Canaveral, Florida</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Vessel noise
Weapons noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices
In-water electromagnetic devices

Entanglement:
None</td></tr>
</table>

Surface Warfare			
Maritime Security Operations			
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediments and Water Quality:** Metals Other materials		
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike **Public Health and Safety:** Physical interactions In-water energy		
Military Expended Material	**Ingestible Material:** Small caliber projectile (casing only), compression pad or plastic piston, endcap – chaff and flare, flare o-ring **Non-Ingestible Material:** Marine marker	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Maritime Security Operations is a broad term used to describe activities intended to train naval forces in the skills necessary to protect naval vessels from small boat attack, counter piracy and drug operations (maritime interdiction operations and visit, board, search, and seizure), and protect key infrastructure (e.g. oil platforms). Maritime security operations need to remain broad as naval forces need to be able to tailor training exercises to respond to emergent threats. Maritime Security Operations exercises typically do not involve live fire of weapons. All Maritime Security Operations exercises involve vessel movement, sometimes at high rates of speed (naval vessels maneuvering to overtake suspect vessel and/or small boats [targets] closing in and maneuvering around naval vessels), and some event involve helicopters and boarding parties. Maritime Security Operations training exercises are conducted proximate to naval homeports in Norfolk, Virginia and Jacksonville, Florida including during times of transit into and out of port, as well as during major training exercises. Firing of weapons during offshore exercises is accounted for in gunnery exercises, surface-to-surface activities. Inshore exercises include firing small caliber blank ammunition. Other components associated with chaff and flare use are not expected to float and would sink to the seafloor.		

A.2.9.14 Missile Exercise Air-to-Surface

Surface Warfare			
Missile Exercise Air-to-Surface			
Short Description	Fixed-wing and helicopter aircrews fire air-to-surface missiles at surface targets.	**Typical Duration**	1 hour
Long Description	Fighter, maritime patrol aircraft, and helicopter aircrews fire precision-guided missiles against surface targets. Aircraft involved may be unmanned. Fixed-wing aircraft (fighters or maritime patrol aircraft) approach an at-sea surface target from high altitude, and launch high-explosive precision guided missiles. Helicopters designate at-sea surface targets with a laser or optics for a precision guided high-explosive or non-explosive practice munitions missile. Helicopter launched missiles typically pass through the target's "sail," and, if explosive, detonate at or just below, the water's surface.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft **Targets:** Surface targets **Systems being Trained/Tested:** Air-to-surface missile systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Weapons firing safety Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Weapons noise Vessel noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material Vessel and in-water device strike **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Missile (explosive) fragments, surface target (stationary) fragments **Non-Ingestible Material:** None	**Military Recoverable Material**	Surface targets (mobile)
Sonar and Other Transducer Bins	None		

Surface Warfare	
Missile Exercise Air-to-Surface	
In-Water Explosive Bins	E6 E8 E10
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive missiles and rockets Vessel movement **Explosive Stressors:** *(Section 5.3.3)* Explosive missiles and rockets
Assumptions Used for Analysis	Assume one missile and one target are used per exercise. While missiles could explode above the water's surface after contacting targets, analysis assumes that all warheads explode at or just below the water's surface. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.9.15 Missile Exercise Air-to-Surface – Rocket

<table>
<tr><th colspan="5">Surface Warfare</th></tr>
<tr><th colspan="5">Missile Exercise Air-to-Surface—Rocket</th></tr>
<tr><td>Short Description</td><td colspan="2">Helicopter aircrews fire both precision-guided and unguided rockets at surface targets.</td><td colspan="2">Typical Duration
1 hour</td></tr>
<tr><td>Long Description</td><td colspan="4">Helicopters designate an at-sea surface target with a laser or optics for precision-guided high explosive or non-explosive practice munitions rockets.</td></tr>
<tr><td>Typical Components</td><td colspan="4">Platforms: Rotary-wing aircraft, unmanned aerial systems
Targets: Surface targets
Systems being Trained/Tested: Air-to-surface missile systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Aircraft safety
Weapons firing safety
Unmanned aerial, surface, and subsurface vehicle safety
Towed in-water device safety</td><td colspan="3">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Weapons noise
Vessel noise

Explosives:
In-water explosives
In-air explosives</td><td colspan="2">Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="4">None</td></tr>
<tr><td>Military Expended Material</td><td colspan="2">Ingestible Material:
Rocket (explosive) fragments, surface target (stationary) fragments, flechettes

Non-Ingestible Material:
Rockets (non-explosive), rocket (non-explosive): flechette</td><td>Military Recoverable Material</td><td>Surface target (mobile)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="4">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="4">E3</td></tr>
</table>

Surface Warfare		
Missile Exercise Air-to-Surface—Rocket		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive missiles and rockets Vessel movement	**Explosive Stressors:** *(Section 5.3.3)* Explosive missiles and rockets
Assumptions Used for Analysis	Assume all explosive rockets detonate in the water. Rockets may be used in conjunction with force protection events. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore. Assume 5 percent of nonexplosive practice munitions in Virginia Capes Range Complex and Jacksonville Range Complex are flechette rockets.	

A.2.9.16 Missile Exercise Surface-to-Surface

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Missile Exercise Surface-to-Surface</th></tr>
<tr><td>Short Description</td><td colspan="2">Surface ship crews defend against surface threats (ships or small boats) and engage them with missiles.</td><td>Typical Duration
2-5 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Surface ships launch missiles at surface maritime targets with the goal of destroying or disabling enemy ships or boats.
After detecting and confirming a surface threat, the ship will fire a precision guided surface missile.

Events with destroyers and cruisers will involve long range (over the horizon) Harpoon (or similar) surface missiles. While past Harpoon exercises occurred during sinking exercises, the requirement exists for non-sinking exercise events to certify ship crews. If a sinking exercise target is unavailable, a towed sled would likely be used.

Events with littoral combat and patrol combatant ships will involve shorter range surface missiles, such as Hellfire and Griffin. Events with littoral combat and patrol combatant ships would be to certify ship's crew to defend against "close-in" (less than 10 miles) surface threats.
These exercises are live fire, meaning that a missile is fired down range. Surface missiles could be equipped with either high-explosive or non-explosive warheads.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Surface combatants
Targets: Surface targets
Systems being Trained/Tested: Surface-to-surface missile systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Weapons firing safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Vessel noise
Weapons noise

Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended materials

Energy:
In-air electromagnetic devices

Explosives:
In-water explosives

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Missile (explosive) fragments, surface target (stationary) fragments

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>Surface target (mobile)</td></tr>
</table>

Surface Warfare	
Missile Exercise Surface-to-Surface	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	E6 E10
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Assume one missile and one target used per exercise. While missile could explode above the water's surface after contacting target, analysis assumes all warheads explode at or just below the surface. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.2.9.17 Sinking Exercise

Surface Warfare			
Sinking Exercise			
Short Description	Aircraft, ship, and submarine crews deliberately sink a seaborne target, usually a decommissioned ship made environmentally safe for sinking according to U.S. Environmental Protection Agency standards, with a variety of ordnance.	**Typical Duration** 4-8 hours, possibly over 1-2 days	
Long Description	Ship personnel and aircrew deliver high-explosive ordnance on a seaborne target, (large deactivated vessel), which is deliberately sunk using multiple weapon systems. A sinking exercise is typically conducted by aircraft, surface vessels, and submarines to train in live ordnance delivery on a full-size ship target. The target is typically a decommissioned ship made environmentally safe for sinking according to U.S. Environmental Protection Agency standards. The location is greater than 50 nautical miles from shore and in water depths greater than 6,000 feet. Ship, aircraft, and submarine crews attack with coordinated tactics and deliver a variety of inert and high-explosive ordnance. Typically, the exercise lasts for 4 to 8 hours and possibly over 1 to 2 days; however, it is unpredictable and ultimately ends when the target ship sinks.		
Typical Components	**Platforms:** Fixed-wing aircraft, submarines, surface combatants **Targets:** Ship hulks **Systems being Trained/Tested:** Large-caliber gun systems, missile systems, bombs, torpedoes, small-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes sinking exercise box	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise Weapons noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	None		

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Sinking Exercise</th></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Bomb (explosive) fragments, missile (explosive) fragments, large-caliber projectiles (explosive) fragments, heavyweight torpedo (explosive) fragments, heavyweight torpedo accessories
Non-Ingestible Material:
large-caliber casings, guidance wires; ship hulks</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">Torpedoes:
TORP2</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">E5 E8 E9 E10 E11</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Acoustic Stressors: (Section 5.3.2)
Weapons firing noise
Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement
Small-, medium-, and large-caliber non-explosive practice munitions
Non-explosive missiles and rockets
Non-explosive bombs
Explosive Stressors: (Section 5.3.3)
Explosive medium-caliber and large-caliber projectiles
Explosive missiles and rockets
Explosive bombs
Sinking exercises
Explosives torpedoes</td></tr>
<tr><td>Assumptions Used for Analysis</td><td colspan="3">Exercises occur greater than 50 NM from shore and in water depths greater than 6,000 ft. during daylight hours only. Due to the distance from shore, stressors to human resources were not analyzed for this activity.
The participants and assets typically include:
• 1 full-size target ship hulk
• 1-5 CG, DDG, or LCS ships
• 1-10 F/A-18, or maritime patrol aircraft
• 1 or 2 MH-60 helicopters
• 1 E-2 aircraft for Command and Control
• 1 submarine
• 1-3 range clearance aircraft
• 1-2 Harpoon surface-to-surface or air-to-surface missiles
• 2-4 Maverick or Hellfire air-to-surface missiles
• 2-12 MK-80 series general purpose bombs
• 200 rounds large-caliber projectiles
• 1-2 MK-48 heavyweight submarine-launched torpedo</td></tr>
</table>

A.2.10 Other Training Exercises

A.2.10.1 Elevated Causeway System

Other Training Exercises			
Elevated Causeway System			
Short Description	A temporary pier is constructed off the beach. Supporting pilings are driven into the sand and then later removed.	**Typical Duration**	Up to 20 days for construction and up to 10 days for removal (the pier can be in place for up to 60 days)
Long Description	An Elevated Causeway System (a temporary pier) is constructed off the beach. The pier is built for offloading materials and equipment, and personnel from ships. Support pilings are driven into the sand with an impact hammer. Causeway platforms are then hoisted and secured onto the piles with hydraulic jacks and cranes. The pier is assembled by joining standard causeway sections together and can be assembled in 20 days. The pier, including associated piles, is removed at the conclusion of training. The Elevated Causeway System can be constructed as an individual training event without the support of ships, or during a Joint Logistics Over-the-Shore training event, which can last up to 30 days.		
Typical Components	**Platforms:** Combat logistics ships, fleet support ships, support craft **Targets:** None **Systems being Trained/Tested:** Elevated Causeway System, including impact hammer and vibratory extractor		
Standard Operating Procedures *(Section 2.3.3)*	Pile driving safety	**Typical Locations** **Range Complexes/Testing Ranges:** Navy Cherry Point	**Inshore Waters/Pierside:** Lower Chesapeake Bay
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Pile driving **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Pile driving **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	Pile driving and removal		

Other Training Exercises		
Elevated Causeway System		
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	**Acoustic Stressors:** *(Section 5.3.2)* Pile driving
Assumptions Used for Analysis	None	

A.2.10.2 Precision Anchoring

Other Training Exercises			
Precision Anchoring			
Short Description	Releasing of anchors in designated locations.	**Typical Duration** Up to 1 hour	
Long Description	Ship crews choose the best available anchoring sites. The ship uses all means available to determine its position when anchor is dropped to demonstrate calculating and plotting the anchor's position within 100 yards of center of planned anchorage.		
Typical Components	**Platforms:** Navy ships **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Virginia Capes	**Inshore Waters/Pierside:** Naval Station Mayport, Florida James River and tributaries
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.2.10.3 Search and Rescue

<table>
<tr><th colspan="4">Other Training Exercises</th></tr>
<tr><th colspan="4">Search and Rescue</th></tr>
<tr><td>Short Description</td><td>Helicopter and ship crews rescue military personnel at sea.</td><td colspan="2">Typical Duration
Up to 2 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Helicopter, ship, and submarine crews practice the skills required to recover personnel lost at sea. Helicopters locate survivors and deploy rescue swimmer and rescue basket. Survivors are winched up to the hovering helicopter. Surface ships would conduct man overboard drills and deploy a dummy figure in the water. Ship crews would launch a small boat, direct the recovery of the dummy, and recover the small boat. Submarine crews would maneuver submarine to effect recovery of personnel.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Rotary-wing aircraft, surface combatants, aircraft carriers, amphibious warfare ships, submarines, small boats
Targets: None
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
Mayport , Florida
Kings Bay, Georgia
James River and tributaries</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise
Aircraft noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Aircraft and aerial target strike
Military expended material

Ingestion:
None</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Metals
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None

Non-Ingestible Material:
Marine markers</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">None</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement</td></tr>
</table>

Other Training Exercises	
Search and Rescue	
Assumptions Used for Analysis	Locations are typical, but ships may conduct man overboard training throughout the Study Area.

A.2.10.4 Submarine Navigation

Other Training Exercises			
Submarine Navigation			
Short Description	Submarine crews operate sonar for navigation and detection while transiting into and out of port during reduced visibility.	**Typical Duration**	Up to 2 hours
Long Description	Submarine crews train to operate sonar for navigation. The ability to navigate using sonar is critical for detection while transiting into and out of port during periods of reduced visibility. During this activity the submarine will be surfaced.		
Typical Components	**Platforms:** Submarines **Targets:** None **Systems being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** None	**Inshore Waters/Pierside:** Groton, Connecticut Kings Bay, Georgia Naval Station Mayport, Florida Naval Base Norfolk, Virginia Port Canaveral, Florida
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF3	**High-Frequency:** HF1	
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Other Training Exercises	
Submarine Navigation	
Assumptions Used for Analysis	For biological resource analysis, vessel noise and vessel strike are only analyzed for the periods while the submarines are surfaced, typically brief in nature. Mitigation measures related to vessel movement are only considered during the period of surfacing as well. For human resource stressor analysis, physical disturbance and strike and physical interactions are only analyzed for the periods while the submarine are surfaced, typically brief in nature.

A.2.10.5 Submarine Sonar Maintenance and Systems Checks

Other Training Exercises			
Submarine Sonar Maintenance and Systems Checks			
Short Description	Maintenance of submarine sonar and other system checks are conducted pierside or at sea.	**Typical Duration** Up to 1 hour	
Long Description	A submarine performs periodic maintenance on the AN/BQQ-10 and submarine high-frequency sonar systems while in port or at sea. Submarines conduct maintenance to their sonar systems in shallow water near their homeport, however, sonar maintenance could occur anywhere as the system's performance may warrant.		
Typical Components	**Platforms:** Submarines **Targets:** None **Systems being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Northeast Virginia Capes Other AFTT Areas	**Inshore Waters/Pierside:** Groton, Connecticut Kings Bay, Georgia Norfolk, Virginia Port Canaveral, Florida
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** None	**Public Health and Safety:** In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF3		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	
Assumptions Used for Analysis	"Other AFTT Areas" refers to areas outside of existing range complexes and testing ranges. Activities occurring within 12 NM are pierside.		

A.2.10.6 Submarine Under Ice Certification

Other Training Exercises			
Submarine Under Ice Certification			
Short Description	Submarine crews operate sonar while transiting under ice. Ice conditions are simulated during training and certification events.	**Typical Duration**	Up to 6 hours per day over 5 days
Long Description	Submarine crews train to operate under ice. Ice conditions are simulated during training and certification exercises. A single exercise is comprised of 30 hours of training, spread out over 5 days in 6-hour training sessions.		
Typical Components	**Platforms:** Submarines **Targets:** None **Systems being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended materials **Ingestion:** None	**Energy:** None **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Expended bathythermograph	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**High-Frequency:** HF1		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	
Assumptions Used for Analysis	Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.		

A.2.10.7 Surface Ship Object Detection

Mine Warfare			
Surface Ship Object Detection			
Short Description	Ship crews detect and avoid mines while navigating restricted areas or channels using active sonar.	**Typical Duration**	Up to 2 hours
Long Description	Surface ship crews detect and avoid mines or other underwater hazardous objects while navigating restricted areas or channels using active sonar. A Littoral Combat Ship utilizes unmanned surface vehicles and remotely operated vehicles to tow mine detection (hunting) equipment. Systems will operate from a shallow zone greater than 40 ft. to deep water. Exercises could be embedded within major training exercises.		
Typical Components	**Platforms:** Surface combatants, unmanned surface vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** None	**Inshore Waters/Pierside:** Mayport, Florida Norfolk, Virginia
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1K	**High-Frequency:** HF8	
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	

Mine Warfare	
Surface Ship Object Detection	
Assumptions Used for Analysis	None

A.2.10.8 Surface Ship Sonar Maintenance and Systems Checks

Other Training Exercises		
Surface Ship Sonar Maintenance and Systems Checks		
Short Description	Maintenance of surface ship sonar and other system checks are conducted pierside or at sea.	**Typical Duration** Up to 4 hours
Long Description	This scenario consists of surface ships performing periodic maintenance to the AN/SQS-53 sonar and other ship systems while in port or at sea. This maintenance takes up to 4 hours. Surface ships operate active sonar systems for maintenance while in shallow water near their homeport, however, sonar maintenance could occur anywhere as the system's performance may warrant.	
Typical Components	**Platforms:** Surface combatants **Targets:** None **Systems being Trained/Tested:** Sonar systems	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes Other AFTT Areas **Inshore Waters/Pierside:** Naval Station Mayport, Florida Naval Station Norfolk, Virginia
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** None **Socioeconomic Resources:** None	**Public Health and Safety:** In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material** None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1	**High-Frequency:** HF8
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	"Other AFTT Areas" refers to areas outside of existing range complexes and testing ranges. Activities occurring within 12 NM are pierside.	

A.2.10.9 Waterborne Training

Other Training Exercises			
Waterborne Training			
Short Description	Personnel launch, operate, and recover a variety of small boats to achieve certifications such as coxswain, crewman, and safety observer.	**Typical Duration**	Up to 12 hours
Long Description	Waterborne Training may include qualification and certification as safety observer, safety swimmer, coxswain, and crewman utilizing a variety of small crafts to include but not limited to rigid hull inflatables, aluminum chambered boat, stand-up paddleboards, kayaks, and jet skis. Boat crews train to launch and recover, moor to buoys, anchor, and operate a variety of missions in shallow waters.		
Typical Components	**Platforms:** Small boats **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Northeast Jacksonville Virginia Capes	**Inshore Waters/Pierside:** Cooper River St. Johns River York River James River and tributaries Lower Chesapeake Bay Narragansett Bay, Rhode Island
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials - munitions	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions
Military Expended Material	**Ingestible Material:** Small caliber (casings only) **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		

Other Training Exercises	
Waterborne Training	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	None

A.3 TESTING ACTIVITIES

A.3.1 NAVAL AIR SYSTEMS COMMAND TESTING ACTIVITIES

Naval Air Systems Command activities will generally fall under fleet primary mission areas, such as the testing of airborne mine warfare and anti-submarine warfare weapons and systems. Naval Air Systems Command activities include, but are not limited to, the testing of new aircraft platforms (e.g., the F-35 Joint Strike Fighter aircraft), weapons, and systems (e.g., newly developed sonobuoys) that will ultimately be integrated into fleet training activities. In addition to testing new platforms, weapons, and systems, Naval Air Systems Command also conducts lot acceptance testing of sonobuoys and follow-on testing and evaluation of updated systems in support of fleet operational units. In general, the potential environmental effects from most Naval Air Systems Command testing events are similar to the associated fleet training exercises.

While many of these systems tested by Naval Air Systems Command will ultimately be used by the fleet, testing activities involving the same or similar systems may be conducted in different locations and manners than when conducted by the fleet. Because of these differences, the results of the analysis for testing activities may differ from the results for training activities.

A.3.1.1 Air Warfare

A.3.1.1.1 Air Combat Maneuver Test

Air Warfare			
Air Combat Maneuver Test			
Short Description	Aircrews engage in flight maneuvers designed to gain a tactical advantage during combat.	**Typical Duration** Up to 2 flight hours per aircraft per event	
Long Description	Air combat maneuver is the general term used to describe an air-to-air test 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 air combat maneuver activities.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** None **Systems being Trained/Tested:** Aircraft platforms		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediment and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy

Air Warfare			
Air Combat Maneuver Test			
Military Expended Material	**Ingestible Material:** Per chaff-air: one chaff-air cartridge, one plastic endcap, chaff fibers Per flare: one casing, one compression pad or one plastic piston, one plastic end cap, one O-ring **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	None		
Assumptions Used for Analysis	All combustible material in flares is assumed to be consumed before contact of the casing with the water.		

A.3.1.1.2 Air Platform – Vehicle Test

Air Warfare		
Air Platform - Vehicle Test		
Short Description	Testing performed to quantify the flying qualities, handling, airworthiness, stability, controllability, and integrity of an air platform or vehicle. No explosive weapons are released during an air platform/vehicle test.	**Typical Duration** 2-8 flight hours per event
Long Description	The air platform/vehicle test describes the testing performed to quantify the flying qualities, handling, airworthiness, stability, controllability, and integrity of an air platform/vehicle. Integration of non-weapons system including aerial refueling tests are also conducted as part of an air platform/vehicle test. Test results are compared against design and performance specifications for compliance. The test results are also used to define stability and controllability characteristics and limitations and to improve and update existing analytical and predictive models. A wide variety of fixed-wing and rotary-wing aircraft, including unmanned aerial systems may undergo air platform/vehicle testing. No weapons are released during an Air Platform/Vehicle Test. Aircraft may employ laser detection for targeting systems and trailing antenna. Events may involve two or more fighter jet aircraft and a towed target tractor by a contracted aircraft (e.g., Learjet for laser targeting tests).	
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, unmanned aerial systems **Targets:** None **Systems being Trained/Tested:** Aircraft platforms	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico; Jacksonville; Key West; Navy Cherry Point; Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike; Military expended material **Ingestion:** Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals; Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility; Airborne acoustics; Physical disturbance and strike **Public Health and Safety:** Physical interactions; In-air energy

Air Warfare			
Air Platform - Vehicle Test			
Military Expended Material	**Ingestible Material:** Per one chaff-air: one chaff-air cartridge, one plastic endcap, chaff fibers Per one flare: one compression pad or one plastic piston, one plastic end cap, one O-ring **Non-Ingestible Material:** Bomb (Non-explosive)	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.3.1.1.3 Air Platform Weapons Integration Test

Air Warfare			
Air Platform Weapons Integration Test			
Short Description	Testing performed to quantify the compatibility of weapons with the aircraft from which they would be launched or released. Non-explosive weapons or shapes are used.	**Typical Duration**	Up to 2.5 flight hours per aircraft per event
Long Description	The air platform weapons integration test describes the testing performed to quantify the compatibility of weapons with the aircraft from which they would be released. Tests evaluate the compatibility of the weapon and its carriage, suspension, and launch equipment with the performance and handling characteristics of the designated aircraft. Additional tests assess the ability of the weapon to separate or launch safely from the aircraft at combat velocities, including at supersonic speeds. Test results are compared against design specifications for compliance. The test results are also used to define performance characteristics and to improve and update existing analytical and predictive models.		
Typical Components	**Platforms:** Fixed-wing aircraft, unmanned aerial systems **Targets:** None **Systems being Trained/Tested:** Munitions firing/launching systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Bomb (non-explosive), missile (non-explosive) , air target (drone)	**Military Recoverable Material**	Air target (drone), surface target (stationary)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		

Air Warfare	
Air Platform Weapons Integration Test	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive bombs and mine shapes
Assumptions Used for Analysis	None

A.3.1.1.4 Air-to-Air Weapons System Test

<table>
<tr><th colspan="4">Air Warfare</th></tr>
<tr><th colspan="4">Air-to-Air Weapons System Test</th></tr>
<tr><td>Short Description</td><td>Test to evaluate the effectiveness of air-launched weapons against designated air targets.</td><td colspan="2">Typical Duration
2.5 flight hours per aircraft per event</td></tr>
<tr><td>Long Description</td><td colspan="3">The air-to-air weapons systems test evaluates the performance of air-launched weapons systems against air targets, such as the BQM-34, a high-performance target simulating a strike fighter aircraft. During an air-to-air weapons systems test, a strike fighter aircraft locates, tracks, and, in some tests, fires on an air target used to simulate another strike fighter aircraft using non-explosive ordnance. No testing of explosive weapons is planned.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Fixed-wing aircraft
Targets: Air targets
Systems being Trained/Tested: Munitions firing/launching systems</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Aircraft safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges: Gulf of Mexico
Inshore Waters/Pierside: None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Aircraft noise
Weapons noise
Physical Disturbance and Strike:
Aircraft and aerial target strike
Military expended material
Energy:
In-air electromagnetic devices
Explosives:
None
Ingestion:
None
Entanglement:
Decelerators/parachutes</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants
Sediment and Water Quality:
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">Cultural Resources:
Physical disturbance and strike
Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-air energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None
Non-Ingestible Material:
Missiles (non-explosive), air target (drone), decelerator/parachute-extra-large</td><td>Military Recoverable Material</td><td>Air target (drone)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">None</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Physical Disturbance and Strike: (Section 5.3.4)
Non-explosive missiles and rockets</td></tr>
<tr><td>Assumptions Used for Analysis</td><td colspan="3">None</td></tr>
</table>

A.3.1.1.5 Air-to-Air Gunnery Test – Medium-Caliber

Air Warfare			
Air-to-Air Gunnery Test – Medium-Caliber			
Short Description	Test performed to evaluate the effectiveness of air-to-air guns against designated airborne targets. Fixed-wing aircraft may be used.	**Typical Duration**	2 flight hours per aircraft per event
Long Description	This event is similar to the training event gunnery exercise air-to-air. An air-to-air gunnery test involves the firing of guns from fixed-wing aircraft against a towed aerial banner that serves as the target. Non-explosive rounds are fired, and the targets fired upon are typically towed aerial banners.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Air targets **Systems being Trained/Tested:** Medium-caliber gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Medium-caliber projectiles (non-explosive), medium-caliber casings **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Small-, medium-, and large-caliber non-explosive practice munitions		
Assumptions Used for Analysis	None		

A.3.1.1.6 Air-to-Air Missile Test

Air Warfare	
Air-to-Air Missile Test	
Short Description	Test performed to evaluate the effectiveness of air-launched missiles against designated airborne targets. Fixed-wing aircraft will be used. **Typical Duration:** 2.5 flight hours per aircraft per event
Long Description	This event is similar to the training event missile exercise (air-to-air). Tests are a type of air-to-air weapons system test in which air-to-air missiles (non-explosive) are fired from fixed-wing aircraft against unmanned aerial drones such as BQM-34 and BQM-74.
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Air targets **Systems being Trained/Tested:** Missile firing/launching systems
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Weapons firing safety **Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise; Weapons noise **Physical Disturbance and Strike:** Aircraft and aerial target strike; Military expended material **Energy:** In-air electromagnetic devices **Explosives:** None **Ingestion:** None **Entanglement:** Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediment and Water Quality:** Metals; Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility; Airborne acoustics; Physical disturbance and strike **Public Health and Safety:** Physical interactions; In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Missiles (non-explosive), decelerator/parachute - large and extra-large **Military Recoverable Material:** Air target (drone)
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	None

A.3.1.1.7 Intelligence, Surveillance, and Reconnaissance Test

Air Warfare			
Intelligence, Surveillance, and Reconnaissance Test			
Short Description	Aircrews use all available sensors to collect data on threat vessels.	**Typical Duration** 2-20 flight hours per event	
Long Description	An air warfare intelligence, surveillance, and reconnaissance (ISR) test involves evaluating communications capabilities of aircraft, including unmanned aerial systems that can carry cameras, sensors, communications equipment, or other payloads. New systems are tested at sea to ensure proper communications between aircraft and ships. ISR aircraft systems act as eyes in the sky, relaying raw imagery back to military personnel on the ground or to ships at-sea. The data is processed, analyzed, and shared with U.S. Navy or other U.S. military aircraft or vessels. New ISR technology systems provide combat identification (friend or foe) and are used for aircraft and ship-based communications.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, fixed-wing unmanned aerial systems **Targets:** Air targets **Systems being Trained/Tested:** ISR systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Air target (drone)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	None		
Assumptions Used for Analysis	Surface targets consist of Navy vessels accounted for in unit level training activities.		

A.3.1.2 Anti-Submarine Warfare

Anti-submarine warfare activities involve helicopter and maritime patrol aircraft, ships, and submarines, conducting operations alone or in combination, to enhance or evaluate the ability to locate, track, and neutralize submarines. Anti-submarine warfare tests are intended to evaluate the capabilities of a variety of active and passive sonar systems. Some systems are used to characterize the environment by measuring water depth, for example, whereas others are designed to locate mines and identify, track, and target submarines. Passive sonar systems "listen" for sound by using underwater microphones, called hydrophones, which receive, filter, amplify, and process underwater sound in search of certain acoustic signatures. No sound is introduced into the water when using passive sonar. Passive sonar can indicate the presence, character, and movement of a submarine, to the extent that the submarine generates noise.

Active sonar is the most effective means for locating quiet, modern submarines because active sonar is not dependent on the sound being generated by the submarine. Active sonar transmits pulses of sound that travel through the water, reflect off objects, and return to a receiver. By knowing the speed of sound in water and the time taken for the sound wave to travel to the object and back, active sonar systems can quickly calculate direction and distance from the sonar platform to the underwater object. Being able to accurately track moving submarines is essential to U.S. ship survivability.

Advanced, large-scale anti-submarine warfare events (i.e., anti-submarine warfare coordinated events) involving active sonar are conducted in coordinated, at-sea activities during multidimensional fleet training events involving submarines, ships, fixed-wing aircraft, and helicopters. These integrated training events offer opportunities to conduct testing activities and to train aircrews in the use of new or newly enhanced systems during a large-scale, complex exercise. Coordinated anti-submarine warfare events often involve the full anti-submarine warfare continuum from detecting and tracking a submarine to attacking a target using either exercise torpedoes or simulated weapons. Training events include detection and tracking exercises against "enemy" submarine contacts, torpedo employment exercises against the target, and exercising command and control tasks in a multidimensional battlespace.

The torpedoes released during a torpedo employment exercise are non-explosive. No other weapons are fired during Naval Air Systems Command anti-submarine warfare tests. Anti-submarine warfare sonar systems are deployed from certain classes of surface ships, submarines, helicopters, and fixed-wing patrol aircraft. Helicopters equipped with dipping sonar or sonobuoys are utilized to locate suspect submarines or submarine targets within the training or testing area. In addition, fixed-wing patrol aircrafts are used to deploy both active and passive sonobuoys to assist in locating and tracking submarines during the duration of the test.

Anti-submarine warfare tests include sonobuoy lot acceptance tests, which evaluate the integrity of a series, or lot, of sonobuoys before the lot is turned over to the fleet; dipping sonar tests in both shallow and deep water; torpedo tests (non-explosive warhead); and sonobuoy tests with both coherent (acoustic) and incoherent (explosive) sonobuoys. The types of sound sources tested by Naval Air Systems Command during anti-submarine warfare sonar tests in the Study Area are identified in Table A.1-1, and descriptions of anti-submarine warfare tests are provided in the sections below.

A.3.1.2.1 Anti-Submarine Warfare Torpedo Test

Anti-Submarine Warfare		
Anti-Submarine Warfare Torpedo Test		
Short Description	This event is similar to the training event torpedo exercise. Test evaluates anti-submarine warfare systems onboard rotary-wing and fixed-wing aircraft and the ability to search for, detect, classify, localize, track, and attack a submarine or similar target.	**Typical Duration** 2-6 flight hours per event
Long Description	Similar to a torpedo exercise, an anti-submarine warfare torpedo test evaluates anti-submarine warfare systems onboard rotary-wing (e.g., MH-60R helicopter) and fixed-wing (maritime patrol aircraft P-8) aircraft and the ability to search for, detect, classify, localize, track, and attack a submarine or similar target (e.g., MK-39 EMATT, or MK-30). Both sonobuoys and torpedoes (using the High Altitude Anti-Submarine Warfare Weapon Capability kit) may be delivered at high altitudes to remain clear of high threat areas. The focus of the anti-submarine warfare torpedo test is the operation of non-explosive torpedoes (e.g., MK-46 or MK-54), but other anti-submarine warfare systems are often used during the test. MK-39 (EMATT) or MK-30 targets simulate a submarine threat and are deployed at varying depths and speeds. If available, tests may be conducted using an actual submarine as the target. This activity can be conducted in shallow or deep waters and aircraft can originate from a land base or from a surface ship. The torpedo test culminates with the release of an exercise torpedo against the target and is intended to evaluate the targeting, release, and tracking process of deploying torpedoes from aircraft. All exercise torpedoes used in testing are either running (EXTORP) or non-running (REXTORP) and are non-explosive. Eighty five percent of torpedoes are recovered. A parachute assembly used for aircraft-launched torpedoes is jettisoned and sinks. Ballast (typically lead weights) may be released from the torpedoes to allow for recovery, leaving the ballast to sink to the bottom.	
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft **Targets:** Sub-surface targets **Systems being Trained/Tested:** Torpedoes/torpedo launching systems	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville, Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers; Aircraft noise; Weapons noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike; Vessel and in-water device strike; Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables; Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals; Chemicals other than explosives; Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility; Airborne acoustics; Physical disturbance and strike	**Public Health and Safety:** Physical interactions; In-air energy; In-water energy

Anti-Submarine Warfare			
Anti-Submarine Warfare Torpedo Test			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Expendable bathythermographs, expendable bathythermograph wires, sonobuoys (non-explosive), sonobuoy wires, sub-surface targets (mobile), lightweight torpedo accessories	**Military Recoverable Material**	Lightweight torpedoes (non-explosive), sub-surface targets (mobile)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF5	**Torpedoes:** TORP1	
Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar		
Assumptions Used for Analysis	Assume one torpedo accessory package (ballast, etc.) per torpedo. Assume one target per torpedo.		

A.3.1.2.2 Anti-Submarine Warfare Tracking Test – Helicopter

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Test – Helicopter			
Short Description	This event is similar to the training event anti-submarine tracking exercise–helicopter. The test evaluates the sensors and systems used to detect and track submarines and to ensure that helicopter systems used to deploy the tracking systems perform to specifications.	**Typical Duration** 2 flight hours per event	
Long Description	Similar to an anti-submarine tracking exercise–helicopter, an Anti-Submarine Warfare Tracking Test — helicopter evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications. Typically, one helicopter (e.g., MH-60) conducts anti-submarine warfare testing using the dipping sonar (e.g., AN/AQS–22), non-impulsive sonobuoys (e.g., AN/SSQ-62), passive sonobuoys (e.g., AN/SSQ-53D/E), or explosive sonobuoys (e.g., mini sound-source seeker buoys). Targets (e.g., MK-39 EMATT or MK-30) may also be employed during an anti-submarine warfare tracking test event. If available, tests may be conducted using an actual submarine as the target. This activity would be conducted in shallow or deep waters and could initiate from a land base or from a surface ship. Helicopter anti-submarine warfare tests are intended to evaluate the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications. Some anti-submarine helicopter tracking tests could be conducted as part of an anti-submarine tracking coordinated event with fleet training activities.		
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonobuoys, dipping sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material Vessel and in-water device strike **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Test – Helicopter			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small, sonobuoy (explosive) fragments **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, subsurface target (stationary)	**Military Recoverable Material**	Sub-surface targets (mobile)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF4 MF5		
In-Water Explosive Bins	E3		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Explosive Stressors:** *(Section 5.3.3)* Explosive sonobuoys	
Assumptions Used for Analysis	None		

A.3.1.2.3 Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft			
Short Description	The test evaluates the sensors and systems used by maritime patrol aircraft to detect and track submarines and to ensure that aircraft systems used to deploy the tracking systems perform to specifications and meet operational requirements.	**Typical Duration** 4-6 flight hours per event	
Long Description	Similar to an Anti-Submarine Warfare Tracking Exercise-Maritime Patrol Aircraft, an Anti-Submarine Warfare Tracking Test—Maritime Patrol Aircraft evaluates the sensors and systems used to detect and track submarines and to ensure that platform systems used to deploy the tracking systems perform to specifications and meet operational requirements. P-3 or P-8 fixed-wing aircraft conduct anti-submarine warfare testing using non-impulsive sonobuoys (e.g., AN/SSQ-62 DICASS), explosive sonobuoys (e.g., MK-61 SUS), passive sonobuoys (e.g., AN/SSQ-53 DIFAR), and smoke devices (e.g., MK-58). Targets (e.g., MK-39 EMATT) may also be employed during an anti-submarine warfare scenario. If available, tests may be conducted using an actual submarine as the target. This activity would be conducted in deep (typically beyond 100 ft.) waters. Some anti-submarine warfare maritime patrol aircraft tracking tests could be conducted as part of a coordinated event with fleet training activities.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonobuoys/sonobuoy launching systems, data transmission systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended materials **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Anti-Submarine Warfare			
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small, sonobuoy (explosive) fragments **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, sub-surface target (mobile)	**Military Recoverable Material**	Sub-surface target (mobile)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF5 MF6 **Anti-Submarine Warfare:** ASW2 ASW5		
In-Water Explosive Bins	E1 E3		
Procedural Mitigation Measures	None		
Assumptions Used for Analysis	None		

A.3.1.2.4 Kilo Dip

Anti-Submarine Warfare		
Kilo Dip		
Short Description	Functional check of a helicopter deployed dipping sonar system (e.g., AN/AQS-22) prior to conducting a testing or training event using the dipping sonar system.	**Typical Duration** 1.5 flight hours per event
Long Description	A kilo dip is the operational term used to describe a functional check of a helicopter deployed dipping sonar system. During a functional check, a single helicopter (e.g., MH-60) would transit to an area designated for dipping sonar testing (i.e., a dip point usually close to shore) and would deploy the sonar transducer assembly via a reel mechanism to a predetermined depth or series of depths while the helicopter hovers over the dip point. Once at the desired depth, the sonar transducer would be activated and would briefly transmit a pulsed, acoustic signal (i.e., ping) to check that all systems are functioning properly. After the check is completed, the sonar transducer assembly would be reeled in, and in some instances the helicopter would transit to a second dip point before the procedure is repeated. A kilo dip is a precursor to more comprehensive testing.	
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** None **Systems being Trained/Tested:** Dipping sonar systems	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Northeast Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** None	**Energy:** In-air electromagnetic devices
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** None **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material** None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF4	

Anti-Submarine Warfare	
Kilo Dip	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar
Assumptions Used for Analysis	None

A.3.1.2.5 Sonobuoy Lot Acceptance Test

Anti-Submarine Warfare			
Sonobuoy Lot Acceptance Test			
Short Description	Sonobuoys are deployed from surface vessels and aircraft to verify the integrity and performance of a lot or group of sonobuoys in advance of delivery to the fleet for operational use.	**Typical Duration** 6 flight hours per event	
Long Description	Sonobuoys are deployed from surface vessels and aircraft to verify the integrity and performance of a lot or group of sonobuoys in advance of delivery to the fleet for operational use. Lot acceptance testing would occur for multiple types of sonobuoys including non-impulsive (e.g., AN/SSQ-62 DICASS) and explosive (e.g., MK-61 SUS).		
Typical Components	**Platforms:** Fixed-wing aircraft, surface combatants **Targets:** None **Systems being Trained/Tested:** Sonobuoy systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Key West	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-energy In-water energy
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small, sonobuoy (explosive) fragments **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Low-Frequency:** LF4 **Mid-Frequency:** MF5 MF6	**High-Frequency:** HF5 HF6 **Anti-Submarine Warfare:** ASW2 ASW5	
In-Water Explosive Bins	E1 E3 E4		

Anti-Submarine Warfare		
Sonobuoy Lot Acceptance Test		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	**Explosive Stressors:** *(Section 5.3.3)* Explosive sonobuoys
Assumptions Used for Analysis	Assume one parachute per sonobuoy	

A.3.1.3 Electronic Warfare

A.3.1.3.1 Chaff Test

<table>
<tr><th colspan="4">Electronic Warfare</th></tr>
<tr><th colspan="4">Chaff Test</th></tr>
<tr><td>Short Description</td><td colspan="2">This event is similar to the training event chaff exercise. Chaff tests evaluate newly developed or enhanced chaff, chaff dispensing equipment, or modified aircraft systems against chaff deployment. Tests may also train pilots and aircrews in the use of new chaff dispensing equipment. Chaff tests are often conducted with flare tests and air combat maneuver events, as well as other test events, and are not typically conducted as standalone tests.</td><td>Typical Duration
2-4 flight hours per event</td></tr>
<tr><td>Long Description</td><td colspan="3">Chaff tests are conducted to evaluate newly developed or enhanced chaff dispensing equipment, to ensure other newly developed or modified aircraft systems are compatible with chaff deployment, and to train pilots and aircrew in the use of new chaff dispensing equipment. Fixed-wing, rotary-wing, and tiltrotor aircraft deploy chaff to disrupt threat targeting and missile guidance radars and to defend against an attack (Electronic Protect deployment). Chaff tests are often conducted with flare tests or air combat maneuver events, as well as other tests, rather than as a standalone test. Weapons are not typically fired during chaff tests. Chaff is employed for a number of different tactical reasons, but the end goal is to create a target that will distract enemy radar and weapon systems away from the friendly platform. Chaff may also be employed offensively (Electronic Attack deployment), such as before a major strike to "hide” inbound striking aircraft. Different chaff types (e.g., RR-129A/AL, RR-144A/AL, and RR-170A/AL) are used by a variety of different Navy aircraft; however all chaff consists of a radar reflector material made of thin, narrow, metallic strips cut in various lengths, and is intended to elicit frequency responses which deceive enemy radars. Defensive chaff tests are the most common type of chaff test. In most cases, the chaff test is conducted to evaluate systems on the aircraft deploying the chaff, but it is also critical to view the effect of the chaff from the "enemy" perspective so that radar system operators may practice corrective procedures to overcome the chaff jamming effect. Chaff tests are often designed to gain experience and data from both perspectives. Chaff is typically deployed from an aircraft as the aircraft makes evasive maneuvers to defeat a simulated threat missile or threat aircraft. The chaff deploys in a cloud of the highly reflective filaments and deceives the guidance system of an inbound missile, allowing the aircraft to escape the threat.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Fixed-wing aircraft, rotary-wing aircraft, tiltrotor aircraft
Targets: None
Systems being Trained/Tested: Chaff, chaff dispensing systems</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Aircraft safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Military expended material

Ingestion:
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
</table>

Electronic Warfare			
Chaff Test			
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediments and Water Quality:** Metals Other materials		
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike **Public Health and Safety:** Physical interactions In-air energy		
Military Expended Material	**Ingestible Material:** Per chaff cartridge: one plastic endcap, chaff fibers **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	None		
Assumptions Used for Analysis	None		

A.3.1.3.2 Electronic System Evaluation

Electronic Warfare			
Electronic Systems Evaluation			
Short Description	Test that evaluates the effectiveness of electronic systems to control, deny, or monitor critical portions of the electromagnetic spectrum. In general, electronic warfare testing will assess the performance of three types of electronic warfare systems: electronic attack, electronic protect, and electronic support.	**Typical Duration**	2-6 flight hours per event
Long Description	Electronic systems evaluations are performed to determine the effectiveness of designated electronic warfare systems to control, deny, or monitor critical portions of the electromagnetic spectrum. In general, electronic warfare testing will assess the performance of three types of electronic warfare systems; specifically, electronic attack, electronic protect, and electronic support. Aircraft electronic attack systems are designed to confuse the enemy or deny the enemy the use of its electronically-targeted weapons systems. The suppression of enemy air defenses and active jamming against hostile aircraft and surface combatant radars are examples of the application of electronic attack. Aircraft electronic protect systems are designed to intercept, identify, categorize, and defeat threat weapons systems that are already targeting that or other friendly aircraft. Aircraft electronic support systems employ passive tactics to intercept, exploit, locate (target), collect, collate, and decipher information from the radio frequency spectrum for the purpose of determining the intentions of the radiating source. Test results are compared against design specifications to evaluate the performance of the actually electronic warfare system. The test results are also used to define performance characteristics and to improve and update existing analytical and predictive models.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Air targets, electronic warfare targets **Systems being Trained/Tested:** Electronic warfare systems, radar systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Air target (drone)

Electronic Warfare	
Electronic Systems Evaluation	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	None

A.3.1.3.3 Flare Test

Electronic Warfare		
Flare Test		
Short Description	This event is similar to the training event flare exercise. Flare tests evaluate newly developed or enhanced flares, flare dispensing equipment, or modified aircraft systems against flare deployment. Tests may also train pilots and aircrew in the use of newly developed or modified flare deployment systems. Flare tests are often conducted with chaff tests and air combat maneuver events, as well as other test events, and are not typically conducted as standalone tests.	**Typical Duration** 2 flight hours per event
Long Description	Flare tests are conducted to evaluate new flares, newly developed or modified flare deployment systems, to ensure that other newly enhanced aircraft systems are compatible with flare deployment, and to train pilots and aircrew in the use of newly developed or modified flare deployment systems. Flare tests are often conducted with chaff tests and air combat maneuver events, as well as other test events, and are not typically conducted as stand-alone tests. During a flare test, flares (and in some cases chaff) are deployed, but no weapons are typically fired. Flare dispensers may also be jettisoned during a flare test intended to assess the safe release of the dispenser in the event of an emergency. Rotary-wing and tiltrotor aircraft deploy flares as a defensive tactic (electronic protect deployment) to disrupt the infrared missile guidance systems used by heat-seeking missiles, thereby causing the missile to lock onto the flare instead of onto the aircraft and enabling the aircraft to avoid the threat. In a typical scenario, an aircraft may detect the electronic targeting signals emitted from threat radars or missiles, or aircrew may visually identify a threat missile plume when a missile is launched. At a strategically appropriate time, the pilot dispenses flares and immediately maneuvers the aircraft to distract and defeat the threat. During a typical flare test, an aircraft will dispense flares 3,000 ft. above mean sea level and flares are completely consumed while in the air. Aircraft flares use a magnesium extruded flare grain. Flare types commonly deployed during Naval Air Systems Command testing activities include but are not limited to: MJU-57, MJU-49, and MJU-38 for high speed aircraft and MJU-32 for low speed aircraft.	
Typical Components	**Platforms:** Rotary-wing aircraft, tiltrotor aircraft **Targets:** None **Systems being Trained/Tested:** Flares, flare dispensing systems	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico, Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike; Military expended material **Ingestion:** Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediment and Water Quality:** Other materials

Electronic Warfare			
Flare Test			
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike **Public Health and Safety:** Physical interactions In-air energy		
Military Expended Material	**Ingestible Material:** Per flare: one casing, one compression pad or one plastic piston, one plastic endcap, one O-ring **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
Explosive Bins	None		
Procedural Mitigation Measures	None		
Assumptions Used for Analysis	Other components associated with chaff and flare use are not expected to float and would sink to the seafloor.		

A.3.1.4 Mine Warfare

Mine warfare involves the detection, avoidance, and neutralization of mines to protect Navy ships and submarines and offensive mine laying in naval operations. A naval mine is a self-contained, explosive device placed in the water at predetermined depths to destroy ships or submarines. Naval mines are deposited and left in place until triggered by the approach of or contact with an enemy ship or until removed or otherwise destroyed. Naval mines can be laid by minelayers, other ships, submarines, and aircraft. Naval Air Systems Command mine warfare testing events include airborne mine countermeasures events, mine-laying events (similar to mine exercises), and mine neutralization events. The AN/ASQ-235 airborne mine neutralization system was developed to destroy mines or otherwise rendering them non-functional. The airborne laser mine detection system test, airborne dipping sonar minehunting test, and airborne sonobuoy minehunting test evaluate the capabilities of mine warfare systems to detect, classify, and fix the location of floating, near-surface moored, and bottom moored mines.

A.3.1.4.1 Airborne Dipping Sonar Minehunting Test

Mine Warfare			
Airborne Dipping Sonar Minehunting Test			
Short Description	A mine-hunting dipping sonar system that is deployed from a helicopter and uses high-frequency sonar for the detection and classification of bottom and moored mines.	**Typical Duration**	2 flight hours per event
Long Description	Tests of a mine-hunting dipping sonar system to evaluate the search capabilities of this helicopter-deployed, mine hunting, detection, and classification system. The sonar identifies mine-like objects.		
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Mine shapes (on established mine warfare training range) **Systems being Trained/Tested:** Dipping sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes Naval Surface Warfare Center, Panama City Division	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise	**Physical Disturbance and Strike:** Aircraft and aerial target strike Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediment and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None

Mine Warfare	
Airborne Dipping Sonar Minehunting Test	
Sonar and Other Transducer Bins	**High-Frequency:** HF4
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar
Assumptions Used for Analysis	The activity uses an established mine warfare training range and does not require the placement of moored mines.

A.3.1.4.2 Airborne Laser Based Mine Detection System Test

Mine Warfare			
Airborne Laser-Based Mine Detection System Test			
Short Description	An airborne mine hunting test of a laser-based mine detection system, that is operated from a helicopter (e.g., MH-60) and evaluates the system's ability to detect, classify, and fix the location of floating and near-surface, moored mines. The system uses a low energy laser to locate mines.	**Typical Duration** 2.5 flight hours per event	
Long Description	During an airborne mine detection system test, a helicopter (e.g., MH-60) evaluates the search capabilities of the AN/AES-1 Airborne Laser Mine Detection System. The Airborne Laser Mine Detection System is a mine hunting system designed to detect, classify, and localize floating and near-surface, moored sea mines using a laser system. The Airborne Laser Mine Detection System will be integrated into the helicopter to provide a rapid wide-area reconnaissance and assessment of mine threats in littoral zones, confined straits, choke points, and amphibious objective areas for Carrier and Expeditionary Strike Groups. The Airborne Laser Mine Detection System uses pulsed laser light to image the entire near-surface volume potentially containing mines. Airborne Laser Mine Detection System is capable of day or night operations without stopping to deploy or recover equipment and without towing any equipment in the water. With untethered operations, it can attain high area search rates. This design uses the forward motion of the aircraft to generate image data negating the requirement for complex scanning mechanisms and ensuring high system reliability. Airborne Laser Mine Detection System also provides accurate target geo-location to support follow on neutralization of the detected mines.		
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Mine shapes (on established mine warfare training range) **Systems being Trained/Tested:** Low-energy laser systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes Naval Surface Warfare Center, Panama City Division	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None

Mine Warfare	
Airborne Laser-Based Mine Detection System Test	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	The activity uses an established mine warfare training range and does not require the placement of moored mines.

A.3.1.4.3 Airborne Mine Neutralization Systems Test

Mine Warfare			
Airborne Mine Neutralization System Test			
Short Description	A test of the airborne mine neutralization system evaluates the system's ability to detect and destroy mines from an airborne mine countermeasures capable helicopter (e.g., MH-60). The airborne mine neutralization system uses up to four unmanned underwater vehicles equipped with high-frequency sonar, video cameras, and explosive and non-explosive neutralizers.	**Typical Duration** 2.5 flight hours per event	
Long Description	Mine neutralization tests evaluate aircraft and aircraft systems intended to neutralize or otherwise destroy mines through the use of explosives or other munitions. For most neutralization tests, mine shapes or non-explosive mines are used to evaluate new or enhanced mine neutralization systems. The airborne mine neutralization system uses up to four unmanned underwater vehicles equipped with high-frequency sonar and video cameras to relocate previously detected submerged mines. The unmanned underwater vehicles are also equipped with explosives to neutralize the mines after they are located. Data from unmanned underwater vehicles are relayed to the operator in the helicopter through a fiber-optic cable enabling the operator to position the neutralizing charge onto the most vulnerable area of the mine. The explosive charge is then detonated to neutralize the mine. For most tests, recoverable non-explosive neutralizers are used. A mine shape, rather than an explosive mine, serves as the target and a range support vessel recovers the non-explosive neutralizer and the mine shape following the test. Testing scenarios include a non-explosive neutralizer against an inert mine shape, or an explosive neutralizer against an explosive mine.		
Typical Components	**Platforms:** Rotary-wing aircraft, support craft, unmanned underwater vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** Mine neutralization systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes Naval Surface Warfare Center, Panama City Division	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material Seafloor devices **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals	Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Mine Warfare			
Airborne Mine Neutralization System Test			
Military Expended Material	**Ingestible Material:** Mine (explosive) fragments, neutralizer (explosive) fragments **Non-Ingestible Material:** Fiber optic cans, fiber optic cables, anchor – mines, neutralizer (non-explosive)	**Military Recoverable Material**	Neutralizers (non-explosive), mine shapes (non-explosive)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E4 E11		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	**Explosive Stressors:** *(Section 5.3.3)* Explosive mine countermeasure and neutralization activities	
Assumptions Used for Analysis	None		

A.3.1.4.4 Airborne Sonobuoy Minehunting Test

Mine Warfare			
Airborne Sonobuoy Minehunting Test			
Short Description	A mine-hunting system made up of sonobuoys is deployed from a helicopter. A field of sonobuoys, using high-frequency sonar, is used for detection and classification of bottom and moored mines.	**Typical Duration**	2 flight hours per event
Long Description	Tests of mine-hunting sonobuoys to evaluate the search capabilities of this helicopter-deployed, mine hunting, detection, and classification system. The sonar identifies mine-like objects.		
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Mine shapes (on established mine warfare training range) **Systems being Trained/Tested:** Sonobuoy systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes Naval Surface Warfare Center, Panama City Division	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material Seafloor devices **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediment and Water Quality:** Metals Other materials	Chemicals other than explosives
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - Small **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires	**Military Recoverable Material**	Mine shape (non-explosive)
Sonar and Other Transducer Bins	**High-Frequency:** HF6		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar		

Mine Warfare	
Airborne Sonobuoy Minehunting Test	
Assumptions Used for Analysis	None

A.3.1.4.5 Mine-Laying Test

Mine Warfare		
Mine Laying Test		
Short Description	Fixed-wing aircraft evaluate the performance of mine laying equipment and software systems to lay mines. A mine test may also train aircrew in laying mines using a new or enhanced mine deployment system.	**Typical Duration** 2 flight hours per event
Long Description	During a mine laying test, fixed-wing aircraft evaluate the performance of aircraft mine laying equipment or associated software systems to lay mines using non-explosive mine shapes. A mine test may also train aircrew in the technique of laying mines and in using a new or enhanced mine deployment system. Aircrew typically drop a series of about four non-explosive mine shapes (i.e., MK 76, BDU-45, or BDU-48), making multiple passes in the same flight pattern and dropping one or more shapes each time. The non-explosive mine shapes are expendable and are typically not recovered after the test.	
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Mine shapes **Systems being Trained/Tested:** Mine laying systems	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville, Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike; Military expended material **Ingestion:** None **Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediment and Water Quality:** Metals
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility; Airborne acoustics; Physical disturbance and strike **Public Health and Safety:** Physical interactions; In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Mine shapes (non-explosive)	**Military Recoverable Material:** None
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive bombs and mine shapes	

Mine Warfare	
Mine Laying Test	
Assumptions Used for Analysis	When a test event occurs and aircrew receives training, the event will be analyzed as a testing event.

A.3.1.5 Surface Warfare

Surface warfare is a type of naval warfare in which aircraft, surface ships, and submarines employ weapons, sensors, and operations directed against enemy surface vessels. Naval Air Systems Command surface warfare tests include air-to-surface missile, gunnery, and bombing tests, rocket tests, laser targeting tests, and high-energy laser weapons tests.

A sinking exercise is a specialized fleet training event that provides an opportunity for Naval Air Systems Command aircrew along with ship and submarine crews to deliver explosive ordnance on a deactivated vessel that has been cleaned and environmentally remediated. The vessel is deliberately sunk using multiple weapons systems. A Naval Air Systems Command testing event may take place in conjunction with a sinking exercise to test aircraft or aircraft systems in the delivery of explosive ordnance on a surface target.

A.3.1.5.1 Air-to-Surface Bombing Test

Surface Warfare		
Air-to-Surface Bombing Test		
Short Description	This event is similar to the training event bombing exercise air-to-surface. Fixed-wing aircraft test the delivery of bombs against surface maritime targets with the goal of evaluating the bomb, the bomb carry and delivery system, and any associated systems that may have been newly developed or enhanced.	**Typical Duration** 2 flight hours per event
Long Description	Fixed-wing aircraft test the delivery of bombs against surface maritime targets with the goal of evaluating the bomb, the bomb carry and delivery system, and any associated systems that may have been newly developed or enhanced. Both explosive and non-explosive bombs will be released during this type of test; however, the vast majority of releases will be non-explosive bombs and typically include non-explosive general purpose bombs (e.g., MK 82 and MK 83) and guided bomb units (e.g., GBU-12 and GBU-32) of various sizes. Surface targets may also be used.	
Typical Components	**Platforms:** Fixed-wing aircraft, unmanned aerial systems **Targets:** Surface targets **Systems being Trained/Tested:** Bomb releasing systems	
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** In-water explosives **Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended materials **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Metals Other materials Chemicals other than explosives

Surface Warfare			
Air-to-Surface Bombing Test			
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Bomb (explosive) fragments, surface target (mobile and stationary) fragments **Non-Ingestible Material:** Bombs (non-explosive)	**Military Recoverable Material**	Surface target (mobile)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E9		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive bombs and mine shapes	**Explosive Stressors:** *(Section 5.3.3)* Explosive bombs	
Assumptions Used for Analysis	None		

A.3.1.5.2 Air-to-Surface Gunnery Test

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Air-to-Surface Gunnery Test</th></tr>
<tr><td>Short Description</td><td>This event is similar to the training event gunnery exercise air-to-surface. Fixed-wing and rotary-wing aircrews evaluate new or enhanced aircraft guns against surface maritime targets to test that the gun, gun ammunition, or associated systems meet required specifications or to train aircrew in the operation of a new or enhanced weapons system.</td><td colspan="2">Typical Duration
2-2.5 flight hours per event</td></tr>
<tr><td>Long Description</td><td colspan="3">Fixed-wing and rotary-wing aircrews evaluate new or enhanced aircraft guns against surface maritime targets to test that the gun, gun ammunition, or associated systems meet required specifications or to train aircrew in the operation of a new or enhanced weapons system. Non-explosive practice munitions are typically used during this type of test; however, a small number of high explosive rounds may be used during final testing. Rounds that may be used include 7.62 mm, 20 mm, 30 mm, 0.30-caliber, and 0.50-caliber gun ammunition.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Rotary-wing aircraft, fixed-wing aircraft, tiltrotor aircraft
Targets: Surface targets
Systems being Trained/Tested: Gun systems</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Aircraft safety
Weapons firing safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Weapons noise

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Explosives and explosive byproducts
Metals
Other materials
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike
Explosives</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Medium-caliber projectile (explosive) fragments, small- and medium-caliber projectiles (non-explosive), small-caliber casings, medium-caliber casings, surface targets (stationary) fragments

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>Surface targets (mobile)</td></tr>
</table>

Surface Warfare		
Air-to-Surface Gunnery Test		
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	E1	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Small-, medium-, and large-caliber non-explosive practice munitions	**Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles
Assumptions Used for Analysis	None	

A.3.1.5.3 Air-to-Surface Missile Test

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Air-to-Surface Missile Test</th></tr>
<tr><td>Short Description</td><td colspan="2">This event is similar to the training event missile exercise air-to-surface. Test may involve both fixed-wing and rotary-wing aircraft launching missiles at surface maritime targets to evaluate the weapons system or as part of another systems integration test.</td><td>Typical Duration
2-4 flight hours per event</td></tr>
<tr><td>Long Description</td><td colspan="3">Similar to a missile exercise air-to-surface, an air-to-surface missile test may involve both fixed-wing and rotary-wing aircraft launching missiles at surface maritime targets to evaluate the weapons system or as part of another systems integration test. Air-to-surface missile tests can include high explosive, non-explosive, or non-firing (captive air training missile) weapons. Laser targeting systems may also be used. Both stationary and mobile targets would be utilized during testing.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Fixed-wing aircraft, rotary-wing aircraft, tiltrotor aircraft
Targets: Surface targets
Systems being Trained/Tested: Missile firing/launching systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Aircraft safety
Weapons firing safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Aircraft noise
Weapons noise

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediment and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike
Explosives</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Missile (explosive) fragments, surface target (mobile and stationary) fragments

Non-Ingestible Material:
Missiles (non-explosive)</td><td>Military Recoverable Material</td><td>Surface targets (mobile)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
</table>

Surface Warfare		
Air-to-Surface Missile Test		
In-Water Explosive Bins	E6 E9 E10	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive missiles and rockets	**Explosive Stressors:** *(Section 5.3.3)* Explosive missiles and rockets
Assumptions Used for Analysis	None	

A.3.1.5.4 High-Energy Laser Weapons Test

Surface Warfare			
High-Energy Laser Weapons Test			
Short Description	High-energy laser weapons tests would evaluate the specifications, integration, and performance of an aircraft mounted, approximately 25 kilowatt high-energy laser. The laser is intended to be used as a weapon to disable small surface vessels.	**Typical Duration** 2.5 flight hours per event	
Long Description	During a high-energy laser weapons test, aircrew would evaluate the specifications, integration, and performance of an aircraft mounted, approximately 25 kilowatt high-energy laser that is intended to be used as a weapon against stationary and mobile, unmanned surface targets. The high-energy laser would be employed from a helicopter (e.g., MH-60) either hovering or in forward flight, and is designed to disable the surface vessel, rendering it immobile. The high-energy laser would have a range of up to six kilometers. Unmanned surface targets would be used during the high-energy laser test.		
Typical Components	**Platforms:** Rotary-wing aircraft **Targets:** Surface targets **Systems being Trained/Tested:** High-energy lasers		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Laser safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices High-energy lasers **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** Surface target (mobile and stationary) fragments **Non-Ingestible Material:** None	**Military Recoverable Material**	Surface target (mobile)
Sonar and Other Transducer Bins	None		

Surface Warfare	
High-Energy Laser Weapons Test	
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	None

A.3.1.5.5 Laser Targeting Test

Surface Warfare			
Laser Targeting Test			
Short Description	Aircrews illuminate enemy targets with lasers.	**Typical Duration**	4 flight hours per event
Long Description	During a laser targeting test, aircrews use laser targeting devices integrated into aircraft or weapons systems to evaluate targeting accuracy and precision and to train aircrew in the use of newly developed or enhanced laser targeting devices designed to illuminate designated targets for engagement with laser-guided weapons. No explosive munitions are released during a laser targeting test.		
Typical Components	**Platforms:** Fixed-wing aircraft, rotary-wing aircraft, tiltrotor aircraft, unmanned aerial systems **Targets:** Surface targets **Systems being Trained/Tested:** Laser targeting systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike; Military expended material **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals; Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility; Airborne acoustics; Physical disturbance and strike	**Public Health and Safety:** Physical interactions; In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Bombs (non-explosive)	**Military Recoverable Material**	Surface targets (stationary)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive bombs and mine shapes		
Assumptions Used for Analysis	Military expended material may be non-explosive bombs or other guided munitions.		

A.3.1.5.6 Rocket Test

Surface Warfare			
Rocket Test			
Short Description	Rocket tests are conducted to evaluate the integration, accuracy, performance, and safe separation of guided and unguided 2.75-inch rockets fired from a hovering or forward flying helicopter or tiltrotor aircraft.	**Typical Duration** 1.5-2.5 hours per event	
Long Description	Rocket tests are conducted to evaluate the integration, accuracy, performance, and safe separation of laser-guided and unguided 2.75-inch rockets fired from a hovering or forward flying helicopter. Rocket tests would involve the release of primarily live motor/non-explosive warhead rockets. Some explosive warhead rockets would be tested, and during a jettison test, rockets with a non-explosive motor and non-explosive warhead would be jettisoned along with the rocket launcher. Rocket tests are also conducted to train aircrew on the use of new or enhanced weapons systems. Rocket types may include variations of the Hydra-70 rocket developed under the Advanced Precision Kill Weapons System program or similar munitions developed under Low-cost Guided Imaging Rocket program as well as MEDUSA rockets. Non-explosive warhead rocket types also include flechette rockets. All rockets planned for testing are 2.75-inch rockets. Some rocket tests may be conducted in conjunction with upgrades to or integration of the Forward Looking Infrared targeting system.		
Typical Components	**Platforms:** Rotary-wing aircraft, tiltrotor aircraft **Targets:** Surface targets **Systems being Trained/Tested:** Rocket firing/launching systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Weapons noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Rocket (explosive) fragments, surface target (mobile and stationary) fragments, flechettes **Non-Ingestible Material:** Rockets (non-explosive)	**Military Recoverable Material**	Surface targets (mobile and stationary)

Surface Warfare		
Rocket Test		
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	E3	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Non-explosive missiles and rockets	**Explosive Stressors:** *(Section 5.3.3)* Explosive missiles and rockets
Assumptions Used for Analysis	Assume 25 percent of non-explosive practice munitions are flechette rockets.	

A.3.1.6 Other Testing Activities

A.3.1.6.1 Acoustic and Oceanographic Research

Other Testing Activities			
Acoustic and Oceanographic Research			
Short Description	Active transmissions within the band 10 hertz (Hz)-100 kilohertz (kHz) from sources deployed from ships and aircraft.	**Typical Duration**	8 flight hours per event
Long Description	Active acoustic transmissions within the band 10 Hz-100 kHz used for engineering tests of acoustic sources, validation of ocean acoustic models, characterization of acoustic interactions with the ocean bottom and ocean surface.		
Typical Components	**Platforms:** Fixed-wing aircraft, small boats **Targets:** Sub-surface targets **Systems being Trained/Tested:** Low-energy lasers, de minimis sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Subsurface target (mobile)	**Military Recoverable Material**	Subsurface target (mobile)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		

Other Testing Activities	
Acoustic and Oceanographic Research	
Assumptions Used for Analysis	None

A.3.1.6.2 Air Platform Shipboard Integration Test

Other Testing Activities			
Air Platform Shipboard Integration Test			
Short Description	Aircraft are tested to determine operability from shipboard platforms, performance of shipboard physical operations, and to verify and evaluate communications and tactical data links.	**Typical Duration** 2-12 flight hours per event	
Long Description	The air platform shipboard integration test is performed to evaluate the compatibility of an aircraft to operate from designated shipboard platforms, perform shipboard physical operations, and to verify and evaluate communications and tactical data links. This test function also includes an assessment of carrier-shipboard suitability, such as hazards of electromagnetic radiation to ordnance, hazard of electromagnetic radiation to personnel, and high energy radio frequency.		
Typical Components	**Platforms:** Fixed-wing aircraft, unmanned aerial systems, tiltrotor aircraft **Targets:** None **Systems being Trained/Tested:** Communications systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants		**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	None		

Other Testing Activities	
Air Platform Shipboard Integration Test	
Assumptions Used for Analysis	None

A.3.1.6.3 Maritime Security

Surface Warfare			
Maritime Security Operations			
Short Description	Maritime patrol aircraft participate in maritime security activities and fleet training events. Aircraft identify, track, and monitor foreign merchant vessels suspected of non-compliance with United Nations-allied sanctions or conflict rules of engagement.	**Typical Duration** 2-8 flight hours per event	
Long Description	Crews from Navy fixed-wing aircraft identify, track, and monitor foreign merchant vessels suspected of not complying with United Nations-allied sanctions or conflict rules of engagement. This training event is non-firing. Naval Air Systems Command maritime patrol aircraft may participate in maritime security activities and training events.		
Typical Components	**Platforms:** Fixed-wing aircraft **Targets:** Mobile surface vessels **Systems being Trained/Tested:** Radar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Navy Cherry Point Virginia Capes	**Bays/Estuaries/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	None		

Surface Warfare	
Maritime Security Operations	
Assumptions Used for Analysis	None

A.3.1.6.4 Shipboard Electronic Systems Evaluation

Other Testing Activities			
Shipboard Electronic Systems Evaluation			
Short Description	Tests measure ship antenna radiation patterns and test communication systems with a variety of aircraft.	**Typical Duration** 2-20 flight hours per event	
Long Description	Shipboard electronic systems evaluation tests measure ship antenna radiation patterns and evaluate communication systems linking vessels and aircraft. Aircraft capable of landing on a ship (e.g., aircraft carrier or littoral combat ship) temporarily deploy to a nearshore ship and conduct a variety of tests over a period of days to test newly installed or modified systems onboard the aircraft for compatibility with shipboard electronic systems. Follow-on test and evaluation of unmanned aerial systems would consist of dynamic interface testing, shipboard electromagnetic testing, and envelope expansion tests intended to evaluate capability of aircraft to conduct launch and recovery operations from a ship at sea as well as perform missions in a maritime environment. Altitudes would range from mean seal level to 15,000 ft. above mean sea level with the majority of flights occurring between mean sea level and 3,000 ft. Shipboard testing of new technology systems to provide precision guidance to aircraft landing on air capable ships. At-sea flight test of the aircraft would consist of shipboard compatibility (dynamic interface/envelope expansion) and, during Operational Evaluation, amphibious assault scenarios. Shipboard electronic systems evaluation tests of aircraft would also involve flight and wind envelope expansion interface testing with Amphibious Assault Ships, Amphibious Transport Dock, and Dock Landing Ship class vessels.		
Typical Components	**Platforms:** Rotary-wing aircraft, unmanned aerial systems **Targets:** None **Systems being Trained/Tested:** Communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None

Other Testing Activities	
Shipboard Electronic Systems Evaluation	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	None
Assumptions Used for Analysis	Surface targets consist of Navy vessels accounted for in unit level training activities.

A.3.1.6.5 Undersea Range System Test

Other Testing Activities			
Undersea Range System Test			
Short Description	Following installation of a Navy undersea warfare training and testing range, tests of the nodes (components of the range) are conducted to include node surveys and testing of node transmission functionality.	**Typical Duration** 8 hours	
Long Description	The bottom-mounted bi-directional nodes are surveyed post-installation utilizing a range pinger and tested to establish system parameters and baseline hearing ranges. Each acoustic projector is activated at full power while listening is occurring on adjacent hydrophones. The nodes may also be activated during periodic operational and maintenance checks and following significant weather events to confirm that nodes are located correctly and functioning properly prior to ongoing training or testing.		
Typical Components	**Platforms:** Surface combatants **Targets:** None **Systems being Trained/Tested:** Undersea range instrumentation		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	

Other Testing Activities	
Undersea Range System Test	
Assumptions Used for Analysis	The duration of the node survey varies. Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.3.2 Naval Sea Systems Command Testing Activities

A.3.2.1 Anti-Submarine Warfare

A.3.2.1.1 Anti-Submarine Warfare Mission Package Testing

Anti-Submarine Warfare			
Anti-Submarine Warfare Mission Package Testing			
Short Description	Ships and their supporting platforms (e.g., helicopters, unmanned aerial systems) detect, localize, and attack submarines.	**Typical Duration**	1-2 weeks, with 4-8 hours of active sonar use with intervals of non-activity in between
Long Description	Littoral combat ships conduct detect-to-engage operations against modern diesel-electric and nuclear submarines using airborne and surface assets (both manned and unmanned). Active and passive acoustic systems are used to detect and track submarine targets, culminating in the deployment of lightweight torpedoes to engage the threat.		
Typical Components	**Platforms:** Rotary-wing aircraft, surface combatants, unmanned aerial systems, unmanned surface vehicles **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, countermeasure systems, torpedo systems, sonobuoys		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes Naval Undersea Warfare Center Division, Newport	**Inshore Waters/Pierside:** Newport, Rhode Island
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Chemicals other than explosives Other materials	Metals
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wires, expendable bathythermographs, expendable bathythermograph wires, lightweight torpedo accessories	**Military Recoverable Material**	Lightweight torpedoes (non-explosive)

Anti-Submarine Warfare	
Anti-Submarine Warfare Mission Package Testing	
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1, MF5, MF4, MF12 **Anti-Submarine Warfare:** ASW1, ASW3, ASW2, ASW5 **Torpedoes:** TORP1
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	All sonobuoys have parachutes unless otherwise noted. Sub-surface targets are submarines.

A.3.2.1.2 At-Sea Sonar Testing

<table>
<tr><th colspan="3">Anti-Submarine Warfare</th></tr>
<tr><th colspan="3">At-Sea Sonar Testing</th></tr>
<tr><td>Short Description</td><td>At-sea testing to ensure systems are fully functional in an open ocean environment.</td><td>Typical Duration
From 4 hours to 11 days</td></tr>
<tr><td>Long Description</td><td colspan="2">At-sea sonar testing is required to calibrate or document the functionality of sonar and torpedo systems while the ship or submarine is in an open ocean environment. At-sea sonar testing is conducted to verify the ship meets design acoustic specifications, define the underwater characteristics of the ship, determine effects of systems and equipment on ship's acoustic characteristics, and provide technical background necessary to initiate development of design improvements to reduce noise. Tests also consist of electronic support measurement, photonics, and sonar sensor accuracy testing. In some instances, a submarine's passive detection capability is tested when a second submarine utilizes its active sonar or is equipped with a noise augmentation system in order to replicate acoustic or electromagnetic signatures of other vessel types or classes.</td></tr>
<tr><td>Typical Components</td><td colspan="2">Platforms: Submarines, surface combatants, support craft
Targets: Sub-surface targets, surface targets
Systems being Trained/Tested: Sonar systems, acoustic countermeasures, sonobuoys, acoustic modems, torpedo systems, underwater communication systems, electromagnetic devices</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Towed in-water device safety</td><td>Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Navy Cherry Point
Northeast
Virginia Capes
Naval Undersea Warfare Center Division, Newport
South Florida Ocean Measurement Facility
Offshore of Fort Pierce, Florida
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="2">Acoustic:
Sonar and other transducers
Vessel noise
Explosives:
None
Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended material
Ingestion:
Military expended materials – other than munitions
Energy:
In-water electromagnetic devices
In-air electromagnetic devices
Entanglement:
Wires and cables
Decelerators/parachutes</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants
Sediments and Water Quality:
Metals
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="2">Cultural Resources:
Physical disturbance and strike
Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
</table>

Anti-Submarine Warfare			
At-Sea Sonar Testing			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Acoustic countermeasures, expendable bathythermographs, expendable bathythermograph wires, heavyweight torpedo accessories, lightweight torpedo accessories, guidance wires, sonobuoys (non-explosive), sonobuoy wires, sub-surface target (mobile)	**Military Recoverable Material**	Electromagnetic devices, heavyweight torpedoes (non-explosive), surface launched lightweight (non-explosive) torpedoes
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF5 MF1K MF9 MF3 **Torpedoes:** TORP2	**Low-Frequency:** LF5 **High-Frequency:** HF1	**Anti-Submarine Warfare:** ASW3 ASW4 **Acoustic Modems:** M3
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	
Assumptions Used for Analysis	Active sonar use is intermittent throughout the duration of the event.		

A.3.2.1.3 Countermeasure Testing

<table>
<tr><th colspan="3">Anti-Submarine Warfare</th></tr>
<tr><th colspan="3">Countermeasure Testing</th></tr>
<tr><td>Short Description</td><td>Countermeasure testing involves the testing of systems that will detect, localize, and track incoming weapons, including marine vessel targets. Testing includes surface ship torpedo defense systems and marine vessel stopping payloads.</td><td>Typical Duration
From 4 hours to 6 days, depending on the countermeasure being tested</td></tr>
<tr><td>Long Description</td><td colspan="2">Countermeasure testing involves the testing of systems that will detect, localize, and track incoming weapons, including marine vessel targets. At-sea testing of the Surface Ship Torpedo Defense systems includes towed acoustic systems, torpedo warning systems, and countermeasure anti-torpedo subsystems. Some countermeasure scenarios would employ non-explosive torpedoes against targets released by secondary platforms (helicopter or submarine). While surface vessels are in transit, countermeasure systems may be used to identify false alert rates. Testing of the maritime vessel stopping payloads will deliver the appropriate measure(s) to affect a target vessel's propulsion and associated control surfaces to significantly slow and potentially stop the advance of the vessel.</td></tr>
<tr><td>Typical Components</td><td colspan="2">Platforms: Aircraft carriers, support craft, surface combatants
Targets: Sub-surface targets, surface targets
Systems being Trained/Tested: Sonar systems, countermeasures, torpedo systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Towed in-water device safety</td><td>Typical Locations
Range Complexes/Testing Ranges:
Key West
Gulf of Mexico
Jacksonville
Northeast
Virginia Capes
Naval Undersea Warfare Center Division, Newport
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="2">Acoustic:
Sonar and other transducers
Vessel noise
Explosives:
None
Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended material
Ingestion:
Military expended materials – other than munitions
Energy:
In-air electromagnetic devices
Entanglement:
Wires and cables
Decelerators/parachutes
Biodegradable polymer</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants
Sediments and Water Quality:
Metals
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="2">Cultural Resources:
Physical disturbance and strike
Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
</table>

Anti-Submarine Warfare			
Countermeasure Testing			
Military Expended Material	**Ingestible Material:** Biodegradable polymer **Non-Ingestible Material:** Anti-torpedo torpedoes, anti-torpedo torpedo accessories, heavyweight torpedo accessories, guidance wires, sub-surface targets (mobile)	**Military Recoverable Material**	Heavyweight torpedoes (non-explosive)
Sonar and Other Transducer Bins	**High-Frequency:** HF5	**Anti-Submarine Warfare:** ASW3	**Torpedoes:** TORP1 TORP2
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	
Assumptions Used for Analysis	Not all events will include the use of sonar and other transducers.		

A.3.2.1.4 Pierside Sonar Testing

<table>
<tr><th colspan="4">Anti-Submarine Warfare</th></tr>
<tr><th colspan="4">Pierside Sonar Testing</th></tr>
<tr><td>Short Description</td><td colspan="2">Pierside testing to ensure systems are fully functional in a controlled pierside environment prior to at-sea test activities.</td><td>Typical Duration
Up to 3 weeks total per ship, with each source run independently and not continuously during this time</td></tr>
<tr><td>Long Description</td><td colspan="3">Ships and submarines would activate mid- and high-frequency tactical sonars, underwater communications systems, and navigational devices to ensure they are fully functional prior to at-sea test events. Testing may also include the firing of inert torpedo shapes.
Event duration varies; with average durations of 3 weeks with active sonar used intermittently over 2 days during the total event duration. This also includes pierside sonar testing during surface combatant sea trials.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Moored platforms, submarines, surface combatants
Targets: None
Systems being Trained/Tested: Sonar systems, acoustic modems, underwater communication systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>None</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
None
Inshore Waters/Pierside:
Bath, Maine
Groton, Connecticut
Kings Bay, Georgia
Newport, Rhode Island
Norfolk, Virginia
Pascagoula, Mississippi
Port Canaveral, Florida
Kittery, Maine</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Sonar and other transducers

Explosives:
None</td><td>Physical Disturbance and Strike:
None

Ingestion:
None</td><td>Energy:
None

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
None</td><td colspan="2">Sediments and Water Quality:
None</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
None</td><td>Socioeconomic Resources:
None</td><td>Public Health and Safety:
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td>Mid-Frequency:
MF1 MF9
MF1K MF10
MF3</td><td>High-Frequency:
HF1 HF8
HF3</td><td>Acoustic Modems:
M3

Anti-Submarine Warfare:
ASW3</td></tr>
</table>

Anti-Submarine Warfare	
Pierside Sonar Testing	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar
Assumptions Used for Analysis	Event duration is 3 weeks with active sonar used intermittently. The facility platform may be a dock or other structure.

A.3.2.1.5 Submarine Sonar Testing/Maintenance

Anti-Submarine Warfare			
Submarine Sonar Testing/Maintenance			
Short Description	Pierside testing of submarine systems occurs periodically following major maintenance periods and for routine maintenance.	**Typical Duration** Up to three weeks, with intermittent use of active sonar	
Long Description	Following major and routine maintenance periods, pierside testing and maintenance is required. Multiple systems with active and passive acoustic sources such as navigation systems, fathometers, underwater communications systems, underwater distress beacons, range finders, and other similar systems, will be tested.		
Typical Components	**Platforms:** Submarines **Targets:** None **Systems being Trained/Tested:** Sonar systems, acoustic modems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** None	**Inshore Waters/Pierside:** Norfolk, Virginia Kittery, Maine
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers **Explosives:** None	**Physical Disturbance and Strike:** None **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** None	**Public Health and Safety:** In-water energy Physical interactions
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF3	**High-Frequency:** HF1 HF3	**Acoustic Modems:** M3
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar		
Assumptions Used for Analysis	Sonar would not be used continuously throughout the duration of the test.		

A.3.2.1.6 Surface Ship Sonar Testing/Maintenance

Anti-Submarine Warfare			
Surface Ship Sonar Testing/Maintenance			
Short Description	Pierside and at-sea testing of ship systems occurs periodically following major maintenance periods and for routine maintenance.	**Typical Duration** Up to 3 weeks, with intermittent use of active sonar	
Long Description	Following major and routine maintenance periods, pierside and at-sea testing and maintenance is required. Multiple systems with active and passive acoustic sources such as tactical sonar, navigation systems, fathometers, underwater communications systems, underwater distress beacons, range finders, and other similar systems, will be tested.		
Typical Components	**Platforms:** Surface combatants **Targets:** None **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures, underwater communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** Mayport, Florida Norfolk, Virginia
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF9 MF1K MF10	**Anti-Submarine Warfare:** ASW3	
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Anti-Submarine Warfare	
Surface Ship Sonar Testing/Maintenance	
Assumptions Used for Analysis	Sonar will not be continuously active for the duration of the test.

A.3.2.1.7 Torpedo (Explosive) Testing

Anti-Submarine Warfare	
Torpedo (Explosive) Testing	
Short Description	Air, surface, or submarine crews employ explosive and non-explosive torpedoes against artificial targets. **Typical Duration** 1-2 days during daylight hours
Long Description	Non-explosive and explosive torpedoes (carrying a warhead) will be launched at a suspended target by a submarine and fixed- or rotary-wing aircraft or surface combatants. Event duration is 1 to 2 days during daylight hours.
Typical Components	**Platforms:** Fixed-wing aircraft, moored platforms, rotary-wing aircraft, submarines, support craft, surface combatants **Targets:** Sub-surface targets, surface targets **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures, sonobuoys, torpedo systems
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety **Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes Offshore of Fort Pierce, Florida **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** In-water explosives **Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediment and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike **Public Health and Safety:** Physical interactions In-air energy In-water energy

Anti-Submarine Warfare			
Torpedo (Explosive) Testing			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small, target fragments, heavyweight torpedo (explosive) fragments, lightweight torpedo (explosive) fragments **Non-Ingestible Material:** Sonobuoys (non-explosive), sonobuoy wire, anti-torpedo torpedoes, anti-torpedo torpedo accessories, guidance wires, expendable bathythermographs, expendable bathythermograph wires, heavyweight torpedo accessories, lightweight torpedo accessories, surface targets (mobile and stationary), sub-surface targets (mobile)	**Military Recoverable Material**	Heavyweight torpedoes (non-explosive), lightweight torpedoes (non-explosive)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF5 MF3 MF6 MF4 **High-Frequency:** HF1 HF6 HF5 **Anti-Submarine Warfare:** ASW3 **Torpedoes:** TORP1 TORP2		
In-Water Explosive Bins	E8 E11		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement **Explosive Stressors:** *(Section 5.3.3)* Explosive torpedoes		
Assumptions Used for Analysis	All sonobuoys have parachutes unless otherwise noted. Only one heavyweight torpedo test could occur in 1 day; two heavyweight torpedo tests could occur on consecutive days. Two lightweight torpedo tests could occur in a single day. All non-explosive torpedoes are recovered.		

A.3.2.1.8 Torpedo (Non-Explosive) Testing

Anti-Submarine Warfare			
Torpedo (Non- Explosive) Testing			
Short Description	Air, surface, or submarine crews employ non-explosive torpedoes against submarines, surface vessels or artificial targets.	**Typical Duration**	Up to 2 weeks
Long Description	Aerial, surface, and subsurface assets fire exercise torpedoes against surface or subsurface targets or at no target and programmed with a particular run geometry. Torpedo testing evaluates the performance and the effectiveness of hardware and software upgrades of heavyweight or lightweight torpedoes. It also includes testing of experimental torpedoes. Not all torpedo tests involve acoustics. Exercise torpedoes are recovered, typically from surface ships and helicopters that are specifically crewed and outfitted for torpedo recovery. Event duration is dependent on number of torpedoes fired.		
Typical Components	**Platforms:** Fixed-wing patrol aircraft, moored platforms, rotary-wing aircraft, submarines, support craft, surface combatants **Targets:** Sub-surface targets, surface targets **Systems being Trained/Tested:** Sonar systems, acoustic countermeasures, sonobuoys, torpedoes		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Navy Cherry Point Northeast Virginia Capes Naval Undersea Warfare Center Division, Newport Offshore of Fort Pierce, Florida	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediment and Water Quality:** Metals Other materials	Chemicals other than explosives
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Anti-Submarine Warfare			
Torpedo (Non- Explosive) Testing			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Acoustic countermeasures, expendable bathythermographs, expendable bathythermograph wires, heavyweight torpedo accessories, guidance wires, lightweight torpedo accessories, sonobuoys (non-explosive), sonobuoy wires, sub-surface targets (mobile and stationary)	**Military Recoverable Material**	Heavyweight torpedoes (non-explosive), lightweight torpedoes (non-explosive), acoustic countermeasures
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF5 MF3 MF6 MF4	**High-Frequency:** HF1 HF6 **Anti-Submarine Warfare:** ASW3 ASW4	**Torpedoes:** TORP1 TORP2 TORP3
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	
Assumptions Used for Analysis	All torpedoes are recovered. Events can last up to two weeks and use up to 40 torpedoes. Typically, no more than eight torpedoes are fired per day during daylight hours.		

A.3.2.2 Electronic Warfare

A.3.2.2.1 Radar and Other System Testing

Electronic Warfare			
Radar and Other System Testing			
Short Description	Test may include use of military or commercial radar, communication systems (or simulators), or high-energy lasers. Testing may occur aboard a ship against drones, small boats, rockets, missiles, or other targets.	**Typical Duration** 12 hours per day over a 7-day period	
Long Description	At-sea and docked testing may include use of military or commercial radar, communication systems (or simulators), or high-energy lasers. No subsurface transmission will occur during this testing. Testing of various air and surface targets may include unmanned aerial vehicles, missiles, or small craft (floating cardboard triwalls, towed, anchored, or self-propelled vessels). High-energy laser testing may include tracking, scoring, and neutralization runs with single or multiple targets.		
Typical Components	**Platforms:** Combat logistics ships, rotary-wing aircraft, small boats, submarines, surface combatants **Targets:** Air targets, surface targets **Systems being Trained/Tested:** Radar, high-energy lasers		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety High-energy laser safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes Naval Surface Warfare Center, Panama City Division Naval Undersea Warfare Center Division, Newport South Florida Ocean Measurement Facility	**Inshore Waters/Pierside:** Groton, Connecticut Joint Expeditionary Base Little Creek, Virginia Norfolk, Virginia
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise Weapons noise **Explosives:** In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices In-water electromagnetic devices High-energy lasers **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Electronic Warfare			
Radar and Other System Testing			
Military Expended Material	**Ingestible Material:** Per chaff: one chaff-air cartridge, one plastic endcap, chaff fibers; air target (drone) fragments, missile (explosive) fragments **Non-Ingestible Material:** Missiles (non-explosive), kinetic energy rounds, sabots, air target (drone)	**Military Recoverable Material**	Surface target (mobile and stationary), air target (drone)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Non-explosive missiles and rockets		
Assumptions Used for Analysis	All explosive missiles detonate in air during this test event. High-energy lasers will not be tested pierside.		

A.3.2.3 Mine Warfare

A.3.2.3.1 Mine Countermeasure and Neutralization Testing

<table>
<tr><th colspan="4">Mine Warfare</th></tr>
<tr><th colspan="4">Mine Countermeasure and Neutralization Testing</th></tr>
<tr><td>Short Description</td><td colspan="2">Air, surface, and subsurface vessels neutralize threat mines and mine-like objects.</td><td>Typical Duration
1-10 days, with intermittent use of countermeasure/neutralization systems during this period</td></tr>
<tr><td>Long Description</td><td colspan="3">Mine countermeasure-neutralization and mine system testing is required to ensure systems can effectively neutralize threat (live or inert) mines that will otherwise restrict passage through an area and to ensure U.S. Navy mines remain effective against enemy ships. These systems may be deployed with a variety of ships, aircraft, submarines, or unmanned autonomous vehicles and operate in water depths up to 6,000 feet. Mines are neutralized by cutting mooring cables of buoyant mines, producing acoustic energy that fires acoustic-influence mines, employing radar or laser fields, producing electrical energy to replicate the magnetic signatures of surface ships in order to detonate threat mines, detonation of mines using remotely-operated vehicles, and using explosive charges to destroy threat mines.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Surface combatants, submarines, unmanned autonomous vehicle, moored platforms, fixed-wing aircraft, rotary-wing aircraft
Targets: Mine shapes
Systems being Trained/Tested: Electromagnetic devices, radar, low energy lasers</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Unmanned aerial, surface, and subsurface vehicle safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Virginia Capes
Naval Surface Warfare Center, Panama City Division
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Sonar and other transducers
Aircraft noise
Vessel noise

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended material
Seafloor devices

Ingestion:
Military expended materials – other than munitions</td><td>Energy:
In-water electromagnetic devices
In-air electromagnetic devices

Entanglement:
Wires and cables</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediment and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Other materials
Metals</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike
Explosives</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
</table>

Mine Warfare			
Mine Countermeasure and Neutralization Testing			
Military Expended Material	**Ingestible Material:** Neutralizer (explosive) fragments, mine shape (explosive) **Non-Ingestible Material:** Fiber optic cables, fiber optic cans, mine shapes (non-explosive), anchor - mine	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E4 E11		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	**Explosive Stressors:** *(Section 5.3.3)* Explosive mine countermeasure and neutralization activities	
Assumptions Used for Analysis	None		

A.3.2.3.2 Mine Countermeasure Mission Package Testing

<table>
<tr><th colspan="4">Mine Warfare</th></tr>
<tr><th colspan="4">Mine Countermeasure Mission Package Testing</th></tr>
<tr><td>Short Description</td><td>Vessels and associated aircraft conduct mine countermeasure operations.</td><td colspan="2">Typical Duration
1-2 weeks with intervals of mine countermeasure mission package use during this time</td></tr>
<tr><td>Long Description</td><td colspan="3">Littoral Combat Ships conduct mine detection using unmanned submersible and aerial vehicles, magnetic and acoustic sensor systems deployed by vessel or support helicopters, and laser systems. Mines are then neutralized using magnetic, acoustic, and supercavitating systems.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Rotary-wing aircraft, surface combatants, unmanned aerial systems, unmanned underwater vehicles, unmanned surface vehicles
Targets: Mine shapes
Systems being Trained/Tested: Sonar systems</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Aircraft safety
Unmanned aerial, surface, and subsurface vehicle safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Virginia Capes
Naval Surface Warfare Center, Panama City Division
South Florida Ocean Measurement Facility

Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Sonar and other transducers
Aircraft noise
Vessel noise

Explosives:
In-water explosives

Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended material
Seafloor devices

Ingestion:
Military expended materials – other than munitions

Energy:
In-air electromagnetic devices

Entanglement:
Wires and cables</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Other materials Metals</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">Cultural Resources:
Physical disturbance and strike
Explosives

Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike

Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Neutralizer (explosive) fragments

Non-Ingestible Material:
Fiber optic cables, fiber optic can, mine shapes (non-explosive)</td><td>Military Recoverable Material</td><td>Mine shapes (non-explosive)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">High-Frequency:
HF4

Synthetic Aperture Sonars:
SAS2</td></tr>
</table>

Mine Warfare	
Mine Countermeasure Mission Package Testing	
In-Water Explosive Bins	E4
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices **Explosive Stressors:** *(Section 5.3.3)* Explosive mine countermeasure and neutralization activities
Assumptions Used for Analysis	8 charges per event The in-air low-energy laser stressor was used in analysis of potential impacts on human resources.

A.3.2.3.3 Mine Detection and Classification Testing

Mine Warfare			
Mine Detection and Classification Testing			
Short Description	Air, surface, and subsurface vessels detect and classify mines and mine-like objects. Vessels also assess their potential susceptibility to mines and mine-like objects.	**Typical Duration** Up to 24 days, with up to 12 hours of acoustic activity each day	
Long Description	Mine detection and classification systems require testing to evaluate the capability of generating underwater magnetic and acoustic signature fields as well as sonar systems that can detect, and classify a wide range of threat mines at tactically different water depths. Surface craft may deploy an underwater sensor system that uses ship signature to develop a susceptibility profile against mine-like objects. In order to develop better and safer methods of minesweeping, the Navy is currently testing new systems to detect locate, identify, and avoid mines including a laser airborne mine detection system that uses laser illumination coupled with sensitive electro-optic receivers to find mines in the upper part of the water column. This type of equipment has traditionally been designed for operation from a manned helicopter; however, the Navy is developing the capability to operate from unmanned aerial systems.		
Typical Components	**Platforms:** Moored platforms, rotary-wing aircraft, sea basing ships, small boats, submarines, support craft, surface combatants, remotely operated vehicles, unmanned aerial systems, unmanned underwater vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** Sonar systems, low-energy lasers		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Navy Cherry Point Virginia Capes Naval Surface Warfare Center, Panama City Division South Florida Ocean Measurement Facility Offshore of Riviera Beach, Florida	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Seafloor devices **Ingestion:** None	**Energy:** In-air electromagnetic devices In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Mine Warfare			
Mine Detection and Classification Testing			
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF9 MF1K **High-Frequency:** HF1 HF8 HF4		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Some mine shapes could be deployed for a specific event, and then retrieved afterwards. However, some mine shapes are left in place so that multiple events can use the same shapes without needing to redeploy. The in-air low-energy laser stressor was used in analysis of potential impacts on human resources.		

A.3.2.4 Surface Warfare

A.3.2.4.1 Gun Testing – Large-Caliber

Surface Warfare	
Gun Testing – Large-Caliber	
Short Description	Surface crews test large-caliber guns to defend against surface targets with large-caliber guns. **Typical Duration:** 1-2 weeks
Long Description	Surface combatants conduct surface warfare by detecting, tracking, and prosecuting small-boat threats. Gun testing may also include the surface warfare mission package for the Littoral Combat Ship, which provides a layered strike-defensive capability by use of its embarked support aircraft, medium range surface-to-surface missiles, and 57 millimeter gun weapon system.
Typical Components	**Platforms:** Surface combatants **Targets:** Surface targets **Systems being Trained/Tested:** None
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety Towed in-water device safety
Typical Locations	**Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes Naval Surface Warfare Center, Panama City Division **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** In-water explosives In-air explosives **Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants **Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Other materials Metals
Stressors to Human Resources	**Cultural Resources:** Explosives Physical disturbance and strike **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike **Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Large-caliber projectile (explosive) fragments, surface target (stationary) fragments **Non-Ingestible Material:** Surface target (stationary), large-caliber (non-explosive) projectiles, large-caliber casings
Military Recoverable Material	Surface target (mobile)

Surface Warfare	
Gun Testing – Large-Caliber	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	E3 E5
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions **Explosive Stressors:** *(Section 5.3.3)* Explosive medium- and large-caliber munitions
Assumptions Used for Analysis	None

A.3.2.4.2 Gun Testing – Medium-Caliber

<table>
<tr><th colspan="4">Surface Warfare</th></tr>
<tr><th colspan="4">Gun Testing – Medium-Caliber</th></tr>
<tr><td>Short Description</td><td>Surface crews defend against surface targets with medium-caliber guns.</td><td colspan="2">Typical Duration
1-2 weeks, with intervals of surface warfare mission package use during this time</td></tr>
<tr><td>Long Description</td><td colspan="3">Surface combatants conduct surface warfare by detecting, tracking, and prosecuting small-boat threats. Gun testing may also include the surface warfare mission package on the Littoral Combat Ship, which provides a layered strike-defensive capability by use of its embarked support aircraft, medium range surface-to-surface missiles, and 30 mm gun weapon system.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Surface combatants, rotary-wing aircraft, support craft
Targets: Surface targets
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Weapons firing safety
Towed in-water device safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Key West
Navy Cherry Point
Northeast
Virginia Capes
Naval Surface Warfare Center, Panama City Division

Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Vessel noise
Weapons noise

Explosives:
In-water explosives
In-air explosives

Physical Disturbance and Strike:
Vessel and in-water device strike
Military expended material

Ingestion:
Military expended materials – munitions
Military expended materials – other than munitions

Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Other materials Metals</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">Cultural Resources:
Physical disturbance and strike
Explosives

Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike

Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Medium-caliber projectile (explosive) fragments, surface target (stationary) fragments, medium-caliber (non-explosive) projectiles, medium-caliber projectile casings

Non-Ingestible Material:
Surface targets (stationary)</td><td>Military Recoverable Material</td><td>Surface targets (mobile)</td></tr>
</table>

Surface Warfare	
Gun Testing – Medium-Caliber	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	E1
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions **Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles
Assumptions Used for Analysis	50 or 1,400 rounds are expended per event. Events with 1,400 rounds have 700 explosive and 700 non-explosive rounds per event.

A.3.2.4.3 Gun Testing – Small-Caliber

Surface Warfare			
Gun Testing – Small-Caliber			
Short Description	Surface crews defend against surface targets with small-caliber guns	**Typical Duration**	1 day-2 weeks
Long Description	Small-caliber guns are fired from surface vessels. This testing also includes anti-terrorism/force protection. During this event, surface craft surface targets will make threat profile approaches to the ship. Ship will demonstrate small-caliber gun testing with non-explosive rounds against the threat target. Small-caliber gun testing includes other class ship sea trials and surface warfare mission package testing.		
Typical Components	**Platforms:** Sea basing ships, surface combatants, small boats, rotary-wing aircraft **Targets:** Surface targets **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes Naval Surface Warfare Center, Panama City Division	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Small-caliber projectiles (non-explosive), small-caliber projectile casings, chaff-ship fibers **Non-Ingestible Material:** Surface target (stationary), chaff-ship cartridge	**Military Recoverable Material**	Surface target (mobile)
Sonar and Other Transducer Bins	None		

Surface Warfare	
Gun Testing – Small-Caliber	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions
Assumptions Used for Analysis	500-1,000 rounds are expended per event. Ships may not be conducting tests consistently for the duration of the event.

A.3.2.4.4 Kinetic Energy Weapon Testing

Surface Warfare			
Kinetic Energy Weapon Testing			
Short Description	A kinetic energy weapon uses stored energy released in a burst to accelerate a projectile.	**Typical Duration** 1 day	
Long Description	A kinetic energy weapon uses stored energy released in a burst to accelerate a projectile to more than seven times the speed of sound to a range of up to 200 miles.		
Typical Components	**Platforms:** Surface combatants **Targets:** Air targets, surface targets **Systems being Trained/Tested:** Kinetic energy weapon		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Surface target (stationary) and air target (drone) fragments, large caliber (explosive) fragments **Non-Ingestible Material:** Air target (drone), kinetic energy rounds, sabot – kinetic energy rounds, surface target (stationary), large caliber casings	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		

Surface Warfare	
Kinetic Energy Weapon Testing	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions
Assumptions Used for Analysis	Assume one target is expended per event. Explosive rounds are designed to detonate above the surface target.

A.3.2.4.5 Missile and Rocket Testing

Surface Warfare			
Missile and Rocket Testing			
Short Description	Missile and rocket testing includes various missiles or rockets fired from submarines and surface combatants. Testing of the launching system and ship defense is performed.	**Typical Duration**	1 day-2 weeks
Long Description	Missile and rocket testing includes various missiles or rockets (standard missiles, Water Piercing Missile Launch) fired from submarines and surface combatants. Testing may occur during surface combatant sea trials and surface warfare mission package testing. This activity includes both air warfare and surface warfare events.		
Typical Components	**Platforms:** Submarines, surface combatants **Targets:** Air targets, land targets, surface targets **Systems being Trained/Tested:** Missile and rocket firing systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** In-water explosives In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Other materials Chemicals other than explosives Metals	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Missile (explosive) fragments, rocket (explosive) fragments, air and surface target fragments **Non-Ingestible Material:** Air target (drone), air target (decoy), missiles and rockets (non-explosive)	**Military Recoverable Material**	Air target (drone)

Surface Warfare	
Missile and Rocket Testing	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	E6 E10
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Non-explosive missiles and rockets **Explosive Stressors:** *(Section 5.3.3)* Explosive missiles and rockets
Assumptions Used for Analysis	Targets used during non-explosive tests will be recovered. Explosive missiles will detonate either in the air or at the water's surface. Ships will not be conducting test constantly for the duration of the allotted time. This activity includes both air warfare and surface warfare events, but it captured under the Surface warfare Protective Measures Assessment Protocol for simplicity.

A.3.2.5 Unmanned Systems

A.3.2.5.1 Underwater Search, Deployment, and Recovery

Other Testing Activities		
Underwater Search, Deployment, and Recovery		
Short Description	Various underwater, bottom crawling, robotic, vehicles are utilized in underwater search, recovery, installation, and scanning activities.	**Typical Duration** 1 day
Long Description	Subsurface activities include a variety of underwater vehicles, robotic or autonomous systems, and items placed on the seafloor. Diving activities and special operations training also occur. Other subsurface activities involve manned and unmanned underwater vehicles. All subsurface vehicles are retrieved after use, while most objects (e.g., non-explosive mines) remain for a period of time to be used as testing fixtures.	
Typical Components	**Platforms:** Moored platforms, remotely operated vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** None	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** South Florida Ocean Measurement Facility **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** None **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike; Seafloor devices **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility; Physical disturbance and strike	**Public Health and Safety:** Physical interactions; In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material:** Mine shapes (non-explosive)
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	
Assumptions Used for Analysis	Mines and other objects may be placed on the bottom where they may remain for a period of time. They will eventually be retrieved. Any acoustic sources used during this activity would be de minimis and not quantitatively analyzed and, therefore, are not included under systems.	

A.3.2.5.2 Unmanned Aerial System Testing

<table>
<tr><th colspan="4">Unmanned Systems</th></tr>
<tr><th colspan="4">Unmanned Aerial System Testing</th></tr>
<tr><td>Short Description</td><td colspan="2">Unmanned aerial systems are launched from a platform (e.g., fixed platform or submerged submarine) to test the capability to extend the surveillance and communications range of unmanned underwater vehicles, manned and unmanned surface vehicles, and submarines.</td><td>Typical Duration
1-12 hours</td></tr>
<tr><td>Long Description</td><td colspan="3">Unmanned aerial systems are reusable, uncrewed vehicles capable of controlled, sustained, level flight. Anticipated scenarios of unmanned aerial system testing include both unmanned aerial system launcher testing and using unmanned aerial systems to extend the surveillance and communications range of distributed sensors, unmanned underwater vehicles, manned and unmanned surface vehicles, and submarines. To test unmanned aerial system launcher systems, a subsurface capsule release may be conducted. During testing, a negatively buoyant capsule is deployed underwater and descends to a programmed depth. The capsule then drops a weight, inflates a flotation collar, rises to the surface, and launches an unmanned aerial system. Personnel use radio frequency communications to control and communicate with the unmanned aerial system during its flight. In the event of an extended communications test, an aerostat (helium filled balloon) may be tethered to either a stationary buoy or an unmanned surface vehicle to test the extended range of communications.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Submarines, shore-based facility, support craft, unmanned aerial systems
Targets: Land targets, surface targets
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Unmanned aerial, surface, and subsurface vehicle safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Northeast
Virginia Capes
Naval Undersea Warfare Center Division, Newport
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Aircraft and aerial target strike
Military expended materials

Ingestion:
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Metals Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Endcaps and pistons (non-chaff and flare)

Non-Ingestible Material:
Canister – miscellaneous</td><td>Military Recoverable Material</td><td>None</td></tr>
</table>

Unmanned Systems	
Unmanned Aerial System Testing	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Other components associated with chaff and flare use are not expected to float and would sink to the seafloor.

A.3.2.5.3 Unmanned Surface Vehicle System Testing

<table>
<tr><th colspan="4">Unmanned Systems</th></tr>
<tr><th colspan="4">Unmanned Surface Vehicle System Testing</th></tr>
<tr><td>Short Description</td><td colspan="2">Testing involves the production or upgrade of unmanned surface vehicles. This may include testing of mine detection capabilities, evaluating the basic functions of individual platforms, or complex events with multiple vehicles.</td><td>Typical Duration
Up to 10 days. Some propulsion systems (gilders) could operate continuously for multiple months.</td></tr>
<tr><td>Long Description</td><td colspan="3">Unmanned surface vehicle testing includes assessment of single-vehicle and multi-vehicle technical performance and functionality during mission operations. Most unmanned vehicle mission operations include launch, transit, mission profile execution, and recovery operations. Unmanned surface vehicles are generally remote-controlled, semi-autonomous, modular, multi-mission platforms. Unmanned surface vehicles include rigid hull inflatable boats, cooperative autonomous research platform (autonomous kayaks), and remote-controlled jet skis. Unmanned surface vehicles may be launched from surface vessels, piers, or land. Once launched, the vehicles may be towed or self-propelled to the test area. Unmanned surface vehicles may deploy, tow, operate, or recover payload systems such as tow bodies containing multi-function sensors. Systems on the unmanned surface vehicle may be acoustically active or produce radio-frequency transmissions or provide laser illumination for electro-optical detection.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Unmanned surface vehicles, support craft
Targets: Surface targets
Systems being Trained/Tested: Unmanned surface vehicles</td></tr>
<tr><td>Standard Operating Procedures (Section 2.3.3)</td><td>Vessel safety
Unmanned aerial, surface, and subsurface vehicle safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges: Naval Undersea Warfare Center Division, Newport
Inshore Waters/Pierside: None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike

Ingestion:
None</td><td>Energy:
In-air electromagnetic devices
In-water electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants</td><td>Sediments and Water Quality:
None</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
None</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>Surface targets (stationary)</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
</table>

Unmanned Systems	
Unmanned Surface Vehicle System Testing	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	None

A.3.2.5.4 Unmanned Underwater Vehicle Testing

<table>
<tr><th colspan="4">Unmanned Systems</th></tr>
<tr><th colspan="4">Unmanned Underwater Vehicle Testing</th></tr>
<tr><td rowspan="2">Short Description</td><td rowspan="2" colspan="2">Testing involves the production or upgrade of unmanned underwater vehicles. This may include testing of mine detection capabilities, evaluating the basic functions of individual platforms, or complex events with multiple vehicles.</td><td>Typical Duration</td></tr>
<tr><td>Up to 35 days. Some propulsion systems (gliders) could operate continuously for multiple months.</td></tr>
<tr><td>Long Description</td><td colspan="3">Unmanned underwater vehicle testing ranges from single-vehicle tests to evaluate hydrodynamic parameters, to full mission, multiple vehicle functionality assessments. Most unmanned underwater vehicle operations include a launch, transit, mission profile execution, and recovery operations. Unmanned underwater vehicles include modular, multi-mission platforms and their payloads, and anti-submarine warfare targets. Unmanned underwater vehicles may be launched from aircraft, surface craft, submarines, piers, or land. Once launched, the vehicles are either towed or self-propelled to the test area. Unmanned underwater vehicles may also deploy, tow, operate, or recover remote sensors and payload systems. Systems on or towed by the unmanned vehicle may be acoustically active, produce radio-frequency transmissions or provide laser illumination for electro-optical detection. Vehicle development involves the production and upgrade of new unmanned platforms on which to attach various payloads used for different purposes. Platforms can include unmanned underwater vehicles, unmanned surface vehicles, and unmanned aerial systems. Payload testing assesses various systems that can be incorporated onto unmanned platforms for mine warfare, bottom mapping, and other missions. This type of test can also include multiple vehicles interacting in formations or acting as individual units and includes tests and demonstrations of unmanned underwater vehicles in detecting and classifying mine-like or other buried objects.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Small boats, submarines, support craft, surface combatants, unmanned underwater vehicles, moored platforms
Targets: Mine warfare targets, sub-surface targets, surface targets
Systems being Trained/Tested: Sonar systems, underwater communication systems, unmanned underwater vehicles</td></tr>
<tr><td rowspan="2">Standard Operating Procedures
(Section 2.3.3)</td><td rowspan="2">Vessel safety
Unmanned aerial, surface, and subsurface vehicle safety
Towed in-water device safety</td><td colspan="2">Typical Locations</td></tr>
<tr><td>Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Naval Surface Warfare Center, Panama City Division
Naval Undersea Warfare Center Division, Newport
South Florida Ocean Measurement Facility
Offshore of Riviera Beach, Florida</td><td>Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Sonar and other transducers
Vessel noise

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike
Seafloor devices
Military expended material

Ingestion of Expended Material:
Military expended materials – munitions
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
Decelerators/parachutes
Wires and cables</td></tr>
</table>

Unmanned Systems			
Unmanned Underwater Vehicle Testing			
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** Surface and sub-surface target fragments, lightweight torpedo (explosive) fragments, decelerators/parachutes - small **Non-Ingestible Material:** Anchors -other, lightweight torpedo accessories, sonobuoys (non-explosive), sonobuoy wires, acoustic countermeasures, surface target (stationary and mobile), sub-surface target (stationary)	**Military Recoverable Material**	Surface target (stationary and mobile), sub-surface target (stationary), bottom-placed instruments, mine shapes (non-explosive), lightweight torpedo (non-explosive), anchor-other
Sonar and Other Transducer Bins	**Low-Frequency:** LF5 **Mid-Frequency:** MF9 MF10 **Anti-Submarine Warfare** ASW4	**Forward-Looking Sonar:** FLS2 **High-Frequency:** HF1 HF4 HF5 HF6 HF7	**Synthetic Aperture Sonars:** SAS1 SAS2 SAS3 **Very High-Frequency** VHF1
In-Water Explosive Bins	E8		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices	
Assumptions Used for Analysis	Some mine shapes could be deployed for a specific event, and then retrieved afterwards. However, some mine shapes are left in place so that multiple events can use the same shapes without needing to redeploy. Multiple vehicles may operate simultaneously in one or multiple areas.		

A.3.2.6 Vessel Evaluation

A.3.2.6.1 Aircraft Carrier Sea Trials – Propulsion Testing

Vessel Evaluation			
Aircraft Carrier Sea Trials – Propulsion Testing			
Short Description	Ship is run at high speeds in various formations (e.g., straight-line and reciprocal paths).	**Typical Duration**	1-2 days
Long Description	Propulsion testing is one part of the total aircraft carrier sea trial activity. Propulsion testing includes ship maneuvering, including full-power runs (speeds in excess of 30 knots) and endurance runs in both straight line and reciprocal paths.		
Typical Components	**Platforms:** Aircraft carriers **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Ships may not be traveling in a straight line. Ships will operate across the full spectrum of capable speeds. Ships will not be conducting test constantly for the duration of the allotted time.		

A.3.2.6.2 Large Ship Shock Trial

<table>
<tr><th colspan="4">Vessel Evaluation</th></tr>
<tr><th colspan="4">Large Ship Shock Trial</th></tr>
<tr><td>Short Description</td><td>Underwater detonations against an aircraft carrier or surface combatant.</td><td colspan="2">Typical Duration
Typically over 4 weeks, with one detonation per week. However, smaller charges may be detonated on consecutive days.</td></tr>
<tr><td>Long Description</td><td colspan="3">Each new class (or major upgrade) of surface ships constructed for the Navy may undergo an at-sea shock trial. A shock trial is a series of underwater detonations that sends a shock wave through the ship’s hull to simulate near misses during combat. A series of up to four underwater detonations will be conducted at various distances from the ship (charges are set closer to the ship as the trial progresses).</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Aircraft carriers, support craft, fixed-wing aircraft, rotary-wing aircraft
Targets: None
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Aircraft safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="3">Acoustic:
Vessel noise
Aircraft noise

Explosives:
In-water explosives

Physical Disturbance and Strike:
Vessel and in-water device strike
Aircraft and aerial target strike
Military expended material

Ingestion:
Military expended materials – other than munitions

Energy:
In-air electromagnetic devices

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="3">Air Quality:
Criteria air pollutants

Sediments and Water Quality:
Explosives and explosive byproducts
Chemicals other than explosives
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="3">None</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Ship shock charge fragments

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">E17</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement

Explosive Stressors: (Section 5.3.3)
Ship shock trials</td></tr>
</table>

Vessel Evaluation	
Large Ship Shock Trial	
Assumptions Used for Analysis	Four charges are used per event. Only one event will occur per 5-year period. Ship shock trials will occur in waters deeper than 650 ft. Modeling scenario: Four 40,000-lb. charges Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.3.2.6.3 Air Defense Testing

Vessel Evaluation			
Air Defense Testing			
Short Description	Tests the ship's capability to detect, identify, track, and successfully engage live and simulated targets. Gun systems are tested using non-explosive and explosive rounds.	**Typical Duration**	7 days
Long Description	Air Defense events are conducted in clear and varied electronic attack environments, using a mix of missile firings to verify the ship's capability to detect, identify, track, and successfully engage live and simulated targets. The tests include testing the radar's track load in the presence of debris, long range engagement processing, low-elevation detection and tracking, track load in the presence of electronic attack and chaff, and missile performance. Tests currently include firing of the 5-inch 0.62-caliber gun, and will potentially include a 155 millimeter gun.		
Typical Components	**Platforms:** Surface combatants **Targets:** Air targets **Systems being Trained/Tested:** Radar systems, gun systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes Gulf of Mexico Northeast	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** In-air explosives	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals	Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Vessel Evaluation			
Air Defense Testing			
Military Expended Material	**Ingestible Material:** Chaff-ship fibers, missile (explosive) fragments; large-caliber projectile (explosive) fragments, medium-caliber (non-explosive) projectiles, air target (drone) and (drone) fragments **Non-Ingestible Material:** Large-caliber projectiles (non-explosive), larger caliber projectile casings, missiles (non-explosive), canisters, large-caliber projectile casings, air target (drone) and (decoy), chaff- ship cartridge	**Military Recoverable Material**	Air target (drone)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing **Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions Non-explosive missiles and rockets	
Assumptions Used for Analysis	Ships will not be conducting test constantly for the duration of the allotted time. This activity incorporates components of both surface warfare and air defense events.		

A.3.2.6.4 Hydrodynamic and Maneuverability Testing

<table>
<tr><th colspan="4">Other Testing Activities</th></tr>
<tr><th colspan="4">Hydrodynamic and Maneuverability Testing</th></tr>
<tr><td>Short Description</td><td colspan="2">Submarines maneuver in the submerged operating environment.</td><td>Typical Duration
10 days</td></tr>
<tr><td>Long Description</td><td colspan="3">Hydrodynamic testing is required to validate the control and maneuverability of a submarine in the submerged operating environment.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Submarines
Targets: None
Systems being Trained/Tested: Submersibles</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Key West
Navy Cherry Point
Northeast
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Vessel noise

Explosives:
None</td><td>Physical Disturbance and Strike:
Vessel and in-water device strike

Ingestion:
None</td><td>Energy:
None

Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
None</td><td colspan="2">Sediments and Water Quality:
None</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
None</td><td>Socioeconomic Resources:
Accessibility
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None

Non-Ingestible Material:
None</td><td>Military Recoverable Material</td><td>None</td></tr>
<tr><td>Sonar and Other Transducer Bins</td><td colspan="3">None</td></tr>
<tr><td>In-Water Explosive Bins</td><td colspan="3">None</td></tr>
<tr><td>Procedural Mitigation Measures</td><td colspan="3">Physical Disturbance and Strike: (Section 5.3.4)
Vessel movement</td></tr>
<tr><td>Assumptions Used for Analysis</td><td colspan="3">For biological resource analysis, vessel noise and vessel strike are only analyzed for the periods while the submarines are surfaced, typically brief in nature. Mitigation measures related to vessel movement are only considered during the period of surfacing as well.
For human resource stressor analysis, airborne acoustics, physical disturbance and strike and physical interactions are only analyzed for the periods while the submarine are surfaced, typically brief in nature.</td></tr>
</table>

A.3.2.6.5 In-Port Maintenance Testing

Vessel Evaluation			
In-Port Maintenance Testing			
Short Description	Each combat system is tested to ensure they are functioning in a technically acceptable manner and are operationally ready to support at-sea testing.	**Typical Duration**	3 weeks
Long Description	Each combat system is tested to ensure they are functioning in a technically acceptable manner and are operationally ready to support at-sea Combat System Ship Qualification Trial events. The ship's test plans and procedures, Maintenance Repair/Requirements Cards, and computerized planned maintenance system are used in establishing testing standards for each system and pieces of equipment. Ship's crew, under supervision of subject matter experts, complete all actions and receive remedial training where required. Trouble Observation Reports are written on noted discrepancies.		
Typical Components	**Platforms:** Amphibious warfare ships, surface combatants **Targets:** None **Systems being Trained/Tested:** Radar, low-energy lasers		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** None	**Inshore Waters/Pierside:** Mayport, Florida Norfolk, Virginia
Stressors to Biological Resources and Habitats	**Acoustic:** None **Explosives:** None	**Physical Disturbance and Strike:** None **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** None	**Public Health and Safety:** In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.3.2.6.6 Propulsion Testing

Vessel Evaluation		
Propulsion Testing		
Short Description	Ship is run at high speeds in various formations (straight-line and reciprocal paths).	**Typical Duration** 1 day
Long Description	Propulsion testing is one part of the total sea trial activity. During this event, the ship is tested for maneuverability, including full power and endurance runs.	
Typical Components	**Platforms:** Amphibious warfare ships, fleet support ships, sea basing ships, surface combatants, small boats, specialized high speed vehicles **Targets:** None **Systems being Trained/Tested:** None	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Navy Cherry Point Northeast Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** None **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material** None
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Vessel Evaluation	
Propulsion Testing	
Assumptions Used for Analysis	Ships will not be conducting test constantly for the duration of the allotted time. Ships may not be traveling in a straight line. Ships will operate across the full spectrum of capable speeds. During surface combatant sea trials full-power runs are conducted for a total of 4 hours, and endurance runs are conducted for a total of 2 hours. Testing may occur near Pascagoula, Mississippi when in the Gulf of Mexico.

A.3.2.6.7 Signature Analysis Operations

Vessel Evaluation		
Signature Analysis Operations		
Short Description	Surface ship and submarine testing of electromagnetic, acoustic, optical, and radar signature measurements.	**Typical Duration** Periodically over multiple days
Long Description	Signature analysis activities include electromagnetic, acoustic, optical, and radar signature measurements, recording, and post-run analyses of data of Navy surface and subsurface vessels. These activities include electromagnetic signature measurement, calibration, and detection of submarines, acoustic and magnetic signature detection of unmanned underwater vehicles and surface ships, radar, and optical detection of surface ships. Testing includes intelligence, surveillance, reconnaissance missions.	
Typical Components	**Platforms:** Moored platforms, submarines, support craft, shore based facility **Targets:** None **Systems being Trained/Tested:** Electromagnetic devices, acoustic modems, optical and radar systems, sonar systems	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville; South Florida Ocean Measurement Facility **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers; Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike; Military expended material; Seafloor devices **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Decelerators/parachutes; Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals; Chemicals other than explosives; Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility; Airborne acoustics; Physical disturbance and strike	**Public Health and Safety:** Physical interactions; In-air energy; In-water energy
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Anchors-other, expendable bathythermographs, expendable bathythermograph wires, sonobuoys (non-explosive), sonobuoy wires	**Military Recoverable Material** Anchors – other
Sonar and Other Transducer Bins	**Mid-Frequency:** MF9, MF10 **Low-Frequency:** LF4, LF5, LF6 **High-Frequency:** HF1 **Anti-Submarine Warfare:** ASW2	**Acoustic Modems:** M3

Vessel Evaluation		
Signature Analysis Operations		
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	None	

A.3.2.6.8 Surface Warfare Testing

Vessel Evaluation		
Surface Warfare Testing		
Short Description	Tests the capabilities of shipboard sensors to detect, track, and engage surface targets. Testing may include ships defending against surface targets using explosive and non-explosive rounds, gun system structural test firing and demonstration of the response to Call for Fire against land based targets (simulated by sea based locations).	**Typical Duration** 7 days
Long Description	Surface warfare events are gun weapons system tests conducted in a clear environment to demonstrate the capability of shipboard and remote (helicopter) sensors to detect and track surface or land based (simulated by sea based locations) targets and engage targets with simulated and live gun and missile firings. The event may qualify the ship's surface warfare gun capability to receive track data from the sensors, filter it, calculate ballistics, recommend aimpoint corrections (spots), generate gun orders, select ammunition properly for targets at differing ranges, and deliver surface direct fire on the surface or land based targets. Testing can also include structural test firing.	
Typical Components	**Platforms:** Support craft, surface combatants **Targets:** Electronic warfare targets, surface targets **Systems being Trained/Tested:** Gun systems, electronic warfare systems	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Key West Northeast Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Weapons noise **Explosives:** In-water explosives In-air explosives	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – munitions Military expended materials – other than munitions **Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials Explosives and explosive byproducts Chemicals other than explosives
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike **Public Health and Safety:** Physical interactions In-air energy In-water energy

Vessel Evaluation			
Surface Warfare Testing			
Military Expended Material	**Ingestible Material:** Large- and medium-caliber projectile (explosive) fragments, medium-caliber projectiles (non-explosive), missile (explosive) fragments, surface target (mobile and stationary) fragments **Non-Ingestible Material:** Large-caliber projectiles (non-explosive), missiles (non-explosive)	**Military Recoverable Material**	Surface target (mobile and stationary)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E1 E5 E8		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Weapons firing **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Small-, medium-, and large-caliber non-explosive practice munitions Non-explosive missiles and rockets	**Explosive Stressors:** *(Section 5.3.3)* Explosive medium-caliber and large-caliber projectiles Explosive missiles and rockets	
Assumptions Used for Analysis	Ships will not be conducting tests constantly for the duration of the allotted time.		

A.3.2.6.9 Undersea Warfare Testing

Vessel Evaluation		
Undersea Warfare Testing		
Short Description	Ships demonstrate capability of countermeasure systems and underwater surveillance, weapons engagement and communications systems. This tests ships ability to detect, track, and engage undersea targets.	**Typical Duration** Up to 10 days
Long Description	Undersea warfare events may be comprised of tracking and firing events or tests of hull-mounted sonar system capabilities to detect and avoid torpedo type targets. Tracking and firing events ensure the operability of the undersea warfare suite and its interface with the rotary wing helicopter. Tests include demonstrating the ability of the ship to search, detect and track a target and conduct attacks with exercise torpedoes. Detection and avoidance events may use surface craft and underwater platforms to test the capability of mid- and high-frequency acoustic sources. Subsurface moving targets, rocket and air-dropped weapons, sonobuoys, towed arrays and sub-surface torpedo-like devices may be used. Approximately 1 week of in-port training may precede the event.	
Typical Components	**Platforms:** Rotary-wing aircraft, submarines, support craft, surface combatants **Targets:** Sub-surface targets, surface targets **Systems being Trained/Tested:** Acoustic countermeasures, sonar systems, sonobuoys	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Northeast Virginia Capes South Florida Ocean Measurement Facility **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Aircraft noise Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables Decelerators/parachutes
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Chemicals other than explosives Other materials
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy

Vessel Evaluation			
Undersea Warfare Testing			
Military Expended Material	**Ingestible Material:** Decelerators/parachutes - small **Non-Ingestible Material:** Acoustic countermeasures, heavyweight torpedo accessories, guidance wires, lightweight torpedo accessories, sonobuoys (non-explosive), sonobuoy wires, surface target (stationary), sub-surface targets (mobile)	**Military Recoverable Material**	Heavyweight torpedoes (non-explosive), lightweight torpedoes (explosive), surface target (stationary), sub-surface target (mobile)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF1 MF5 MF1K MF9 MF4 MF10 **High-Frequency:** HF4 HF8 **Anti-Submarine Warfare:** ASW3 ASW4 **Torpedoes:** TORP1 TORP2		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Five targets are utilized per event. All sonobuoys have a parachute unless otherwise noted. Ships will not be conducting test constantly during the duration of the allotted time.		

A.3.2.6.10 Small Ship Shock Trial

Vessel Evaluation			
Small Ship Shock Trial			
Short Description	Underwater detonations are used to test new ships or major upgrades.	**Typical Duration** Typically over 4 weeks, with one detonation per week. However, smaller charges may be detonated on consecutive days.	
Long Description	Each new class (or major upgrade) of surface ships constructed for the Navy may undergo an at-sea shock trial. A shock trial is a series of underwater detonations that sends a shock wave through the ship's hull to simulate near misses during combat. A series of up to four underwater detonations per event will be conducted at various distances from the ship (charges are set closer to the ship as the trial progressives).		
Typical Components	**Platforms:** Support craft, surface combatants, fixed-wing aircraft, rotary-wing aircraft **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Aircraft noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Vessel and in-water device strike Aircraft and aerial target strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Other materials	
Stressors to Human Resources	None		
Military Expended Material	**Ingestible Material:** Ship shock charge fragments **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E16		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel Movement	**Explosive Stressors:** *(Section 5.3.3)* Ship shock trials	

Vessel Evaluation	
Small Ship Shock Trial	
Assumptions Used for Analysis	Four charges are utilized per event Three events will occur during the 5-year period. Will occur in waters deeper than 650 ft. Modeling scenario: Four 10,000-lb. charges Stressors to human resources were not analyzed for this activity since it occurs greater than 12 NM from shore.

A.3.2.6.11 Submarine Sea Trials – Propulsion Testing

Vessel Evaluation			
Submarine Sea Trials – Propulsion Testing			
Short Description	Submarine is run at high speeds in various formations, and at various depths.	**Typical Duration**	Up to 5 days
Long Description	Propulsion testing is one part of the total submarine sea trial activity. During this activity, submarines undergo a controlled deep dive to test depth, emergency surfacing, full-power operations, high speed turns, and extreme depth changes.		
Typical Components	**Platforms:** Submarines **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		

Vessel Evaluation	
Submarine Sea Trials – Propulsion Testing	
Assumptions Used for Analysis	Subs will not be conducting test constantly for the duration of the allotted time. Subs may not be traveling in a straight line. Subs will operate across the full spectrum of capable speeds. For biological resource analysis, vessel noise and vessel strike are only analyzed for the periods while the submarines are surfaced, typically brief in nature. Mitigation measures related to vessel movement are only considered during the period of surfacing as well. For human resource stressor analysis, airborne acoustics, physical disturbance and strike and physical interactions are only analyzed for the periods while the submarine are surfaced, typically brief in nature.

A.3.2.7 Submarine Sea Trials – Weapons System Testing

Vessel Evaluation			
Submarine Sea Trials – Weapons System Testing			
Short Description	Submarine weapons and sonar systems are tested at-sea to meet the integrated combat system certification requirements.	**Typical Duration**	Up to 7 days
Long Description	Submarine weapons and sonar systems are tested at-sea to meet the integrated combat system certification requirements. This test involves subjecting the integrated combat system through rigorous testing which consists of passive and active sonar activities, launching "water slugs" and exercise torpedoes.		
Typical Components	**Platforms:** Moored platforms, submarines, support craft **Targets:** Sub-surface targets **Systems being Trained/Tested:** Acoustic modems, sonar systems, underwater communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Weapons firing safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Northeast Virginia Capes South Florida Ocean Measurement Facility Offshore of Fort Pierce, Florida	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** None **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Chemicals other than explosives Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Heavyweight torpedo accessories, guidance wire	**Military Recoverable Material**	Heavyweight torpedoes (non-explosive), sub-surface target (mobile)
Sonar and Other Transducer Bins	**Mid-Frequency:** MF3 MF9 MF10	**High-Frequency:** HF1	**Torpedoes:** TORP2 **Acoustic Modems:** M3

Vessel Evaluation		
Submarine Sea Trials – Weapons System Testing		
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Submarines will not be conducting test constantly for the duration of the allotted time.	

A.3.2.7.1 Total Ship Survivability Trials

Vessel Evaluation		
Total Ship Survivability Trials		
Short Description	Series of simulated "realistic" weapon hit scenarios with resulting damage and recoverability exercises against an aircraft carrier.	**Typical Duration** 5 days, happening once over a 5-year period.
Long Description	Each new class (or major upgrade) of surface ships constructed for the Navy will undergo an at-sea Total Ship Survivability Trial (TSST). A TSST is a series of realistic weapon hit scenarios. Each scenario simulates a weapon hit, resulting damage, and a subsequent tactical threat during which ship's force attempts to maintain or restore mission capability by containing and controlling the simulated damage, treat crew casualties, and continues to fight. The TSST has been described as being "as close as we can safely get to an actual hit." The goal of the TSST is to demonstrate that the inherent ship design and procedures provide the crew the ability to realign, repair, and contain damage following a simulated weapon hit. It's important to note that the TSST is not a crew assessment. It does not evaluate crew proficiency or training nor does it qualify equipment.	
Typical Components	**Platforms:** Aircraft carriers **Targets:** None **Systems being Trained/Tested:** None	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Virginia Capes **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** None **Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material** None
Sonar and Other Transducer Bins	None	
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Vessel Evaluation	
Total Ship Survivability Trials	
Assumptions Used for Analysis	None

A.3.2.7.2 Vessel Signature Evaluation

<table>
<tr><th colspan="3">Vessel Evaluation</th></tr>
<tr><th colspan="3">Vessel Signature Evaluation</th></tr>
<tr><td>Short Description</td><td>Surface ship, submarine and auxiliary system signature assessments. This may include electronic, radar, acoustic, infrared and magnetic signatures.</td><td>Typical Duration
Typically 1-5 days, up to 20 days depending on the test being conducted</td></tr>
<tr><td>Long Description</td><td colspan="2">Radar cross signature testing of surface ships and submarines is accomplished on new ships and periodically throughout a ship’s life cycle to measure how detectable the ship is to radar. For example, Assessment Identification of Mine Susceptibility assessments are passive electromagnetic and acoustic measurements performed on mine countermeasure ships and on the Littoral Combat Ship mine countermeasure modules (i.e., auxiliary systems) to determine their mine susceptibility using seafloor deployed magnetometers and hydrophones, and a ship-board global positioning sensor tracking system. Signature testing of all surface ships and submarines verifies that each vessel’s signature is within specifications, and may include the use of helicopter-deployed instrumentation, ship-mounted safety and navigation systems, fathometers, tracking devices, radar systems, and underwater communications equipment. Also included in this activity is the Shipboard Electronic Systems Evaluation Facility which conducts measurements of antenna radiation patterns, Federal Aviation Administration identification of Friend or Foe systems, and Tactical Air Navigation Systems.</td></tr>
<tr><td>Typical Components</td><td colspan="2">Platforms: Aircraft carriers, amphibious warfare ships, fixed wing aircraft, rotary-wing aircraft, sea basing ships, small boats, special mission ships, specialized high speed vehicles, submarines, support craft, surface combatants
Targets: None
Systems being Trained/Tested: Radar systems, electromagnetic devices</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Aircraft safety</td><td>Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Jacksonville
Virginia Capes
Inshore Waters/Pierside:
Joint Expeditionary Base Little Creek, Virginia</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="2">Acoustic:
Sonar and other transducers
Aircraft noise
Vessel noise
Explosives:
None
Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Ingestion:
None
Energy:
In-water electromagnetic devices
In-air electromagnetic devices</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants
Sediments and Water Quality:
None</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="2">Cultural Resources:
None
Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None
Non-Ingestible Material:
None</td><td>Military Recoverable Material
None</td></tr>
</table>

Vessel Evaluation	
Vessel Signature Evaluation	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	None

A.3.2.8 Other Testing

A.3.2.8.1 Chemical and Biological Simulant Testing

<table>
<tr><th colspan="3">Other Testing Activities</th></tr>
<tr><th colspan="3">Chemical and Biological Simulant Testing</th></tr>
<tr><td>Short Description</td><td>Chemical-biological agent simulants are deployed against surface ships.</td><td>Typical Duration
3 days</td></tr>
<tr><td>Long Description</td><td colspan="2">The capabilities of surface ship defense systems to detect and protect in the event of chemical and biological attacks are tested. Testing involves the deployment of harmless compounds (i.e., simulants) as substitutes for chemical and biological warfare agents. Because chemical and biological warfare agents remain a security threat, the Department of Defense uses relatively harmless compounds (simulants) as substitutes for chemical and biological warfare agents to test equipment intended to detect their presence. Chemical and biological agent detectors monitor for the presence of chemical and biological warfare agents and protect military personnel and civilians from the threat of exposure to these agents. The simulants trigger a response by sensors in the detection equipment without irritating or injuring personnel involved in testing detectors.

Navy Chemical Agent Simulant 82 (commonly referred to as NCAS-82), glacial acetic acid, triethyl phosphate, sulfur hexafluoride, 1,1,1,2 tetrafluoroethane (a refrigerant commonly known as R134), and 1,1-difluoroethane (a refrigerant commonly known as R-152a) are also referred to as gaseous simulants and can be released in smaller quantities in conjunction with glacial acetic acid or triethyl phosphate releases. The types of biological simulants that may be used include spore-forming bacteria, non-spore-forming bacteria, ovalbumin, bacteriophage MS2, and Aspergillus niger. The simulants are generally dispersed by hand at the detector or by aircraft as a fine mist or aerosol.</td></tr>
<tr><td>Typical Components</td><td colspan="2">Platforms: Fixed-wing aircraft, surface combatants
Targets: None
Systems being Trained/Tested: None</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Vessel safety
Aircraft safety</td><td>Typical Locations
Range Complexes/Testing Ranges:
Jacksonville
Navy Cherry Point
Northeast
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td colspan="2">Acoustic:
Aircraft noise
Vessel noise
Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Energy:
In-air electromagnetic devices
Explosives:
None
Ingestion:
None
Entanglement:
None</td></tr>
<tr><td>Stressors to Physical Resources</td><td colspan="2">Air Quality:
Criteria air pollutants
Sediments and Water Quality:
Chemicals other than explosives</td></tr>
<tr><td>Stressors to Human Resources</td><td colspan="2">Cultural Resources:
None
Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike
Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
None
Non-Ingestible Material:
None</td><td>Military Recoverable Material
None</td></tr>
</table>

Other Testing Activities	
Chemical and Biological Simulant Testing	
Sonar and Other Transducer Bins	None
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Examples of chemical simulants include glacial acetic acid and triethyl phosphate. Examples of biological simulants are spore-forming bacteria, non-spore-forming bacteria, the protein ovalbumin, MS2 bacteriophages, and the fungus *Aspergillus niger.*

A.3.2.8.2 Insertion/Extraction

Other Testing Activities		
Insertion/Extraction		
Short Description	Testing of submersibles capable of inserting and extracting personnel and payloads into denied areas from strategic distances.	**Typical Duration** Up to 30 days
Long Description	Testing of submersibles capable of inserting and extracting personnel and payloads into denied areas from strategic distances. Testing could include the use of forces deployed from submerged submarines while at sea.	
Typical Components	**Platforms:** Submarines **Targets:** None **Systems being Trained/Tested:** Submersibles, sonar systems, acoustic modems	
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Key West; Naval Surface Warfare Center, Panama City Division **Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers; Vessel noise **Explosives:** None **Physical Disturbance and Strike:** Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** None	**Sediments and Water Quality:** None
Stressors to Human Resources	**Cultural Resources:** None **Socioeconomic Resources:** Accessibility; Physical disturbance and strike	**Public Health and Safety:** Physical interactions; In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material:** None
Sonar and Other Transducer Bins	**Mid-Frequency:** MF9	**Acoustic Modems:** M3
In-Water Explosive Bins	None	
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	

Other Testing Activities	
Insertion/Extraction	
Assumptions Used for Analysis	Test will not occur constantly throughout duration of allotted time. For biological resource analysis, vessel noise and vessel strike are only analyzed for the periods while the submarines are surfaced, typically brief in nature. Mitigation measures related to vessel movement are only considered during the period of surfacing as well. For human resource stressor analysis, airborne acoustics, physical disturbance and strike and physical interactions are only analyzed for the periods while the submarine are surfaced, typically brief in nature.

A.3.2.8.3 Line Charge Testing

Other Testing Activities			
Line Charge Testing			
Short Description	Surface vessels deploy line charges to test the capability to safely clear an area for expeditionary forces.	**Typical Duration** 1 day	
Long Description	Line charges are tested to verify the capability to safely clear surf zone areas for sea-based expeditionary operations. Testing is performed on various surf zone clearing systems that use either line charges or explosive arrays to neutralize mine threats. This is a systems development test and only assesses the in-water components of testing. Line charges consist of a 350-ft. detonation cord with explosives lined from one end to the other end in a series of 5-lb. increments.		
Typical Components	**Platforms:** Moored platforms, support craft **Targets:** None **Systems being Trained/Tested:** Submersibles		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety	**Typical Locations** **Range Complexes/Testing Ranges:** Naval Surface Warfare Center, Panama City Division	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** In-water explosives	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Explosives and explosive byproducts Chemicals other than explosives Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike Explosives	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** Line charge fragments **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	E14		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement	**Explosive Stressors:** *(Section 5.3.3)* Line charge testing	

Other Testing Activities	
Line Charge Testing	
Assumptions Used for Analysis	Test will not occur constantly over the duration of the allotted time.

A.3.2.8.4 Acoustic Component Testing

Other Testing Activities			
Acoustic Component Testing			
Short Description	Various surface vessels, moored equipment, and materials are tested to evaluate performance in the marine environment.	**Typical Duration**	1 day to multiple months
Long Description	Various surface activities utilizing the marine environment for testing and evaluation. Sample projects include buoy deployments, vessel entanglement systems, materials testing, and renewable energy devices. Other surface operations involve manned and unmanned surface vehicles. Miscellaneous types of equipment are deployed, including temperature, humidity, magnetic, acoustic, optical, and air quality instrumentation to measure, record, and analyze system effectiveness, dependability, operational parameters, and durability. Surface operations utilize a variety of vessels for deployment of test equipment and for the monitoring of the air, surface, subsurface.		
Typical Components	**Platforms:** Unmanned aerial systems, unmanned surface vehicles, unmanned underwater vehicles **Targets:** None **Systems being Trained/Tested:** Sonar systems, underwater communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** South Florida Ocean Measurement Facility	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	**Low-Frequency:** LF5 **Mid-Frequency:** MF9	**Forward-Looking Sonar:** FLS2 **High-Frequency:** HF5 HF7	**Synthetic Aperture Sonars:** SAS2
In-Water Explosive Bins	None		

Other Testing Activities		
Acoustic Component Testing		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	None	

A.3.2.8.5 Non-Acoustic Component Testing

Other Testing Activities			
Non-Acoustic Component Testing			
Short Description	Testing of towed or floating buoys for communications through radio-frequencies or two-way optical communications between an aircraft and underwater system(s).	**Typical Duration**	3 days (4 hours per day for 3 days)
Long Description	Testing associated with radio frequency communications could occur from towed antennas from surface vessels, from single-transmit buoys released from submarines, or tethered buoys from submarines for two-way communication. Optical communications tests may include communication between helicopter or fixed wing aircraft and manned or unmanned underwater systems, and may also include ground truth sensors mounted on surface craft.		
Typical Components	**Platforms:** Navy ships, small boats, rotary-wing aircraft unmanned underwater vehicles, manned underwater vehicles **Targets:** None **Systems being Trained/Tested:** Communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Aircraft safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Aircraft noise Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Aircraft and aerial target strike Vessel and in-water device strike **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** None	
Stressors to Human Resources	**Cultural Resources:** None	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** None	**Military Recoverable Material**	None
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel Movement		
Assumptions Used for Analysis	None		

A.3.2.8.6 Payload Deployer Testing

Other Testing Activities			
Payload Deployer Testing			
Short Description	Launcher systems are tested to evaluate performance.	**Typical Duration** 1-5 days	
Long Description	Testing is conducted to evaluate the performance of current or future launchers, which are used to deploy objects (e.g., torpedoes, decoys, countermeasures, sensors, unmanned underwater vehicles, and unmanned aerial vehicles). These tests may be performed from a fixed location or a mobile platform. The objects deployed may be operational equipment or mock equipment that is instrumented to evaluate the performance of the launcher system. Various methods may be employed to launch test items. The test items are typically recovered after the test and are usually equipped with an acoustic locator to aid in their recovery.		
Typical Components	**Platforms:** In-water structures, specialized high-speed vehicles, support craft, surface combatants, unmanned surface vehicles, unmanned underwater vehicles **Targets:** None **Systems being Trained/Tested:** None		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Northeast Naval Undersea Warfare Center Division, Newport	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** Military expended materials – other than munitions	**Energy:** In-air electromagnetic devices **Entanglement:** Wires and cables
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** End caps and pistons – non chaff and flare **Non-Ingestible Material:** Concrete slugs, heavyweight torpedo accessories, lightweight torpedo accessories, sabots, guidance wires	**Military Recoverable Material**	Heavyweight torpedoes (non-explosive), lightweight torpedoes (non-explosive)
Sonar and Other Transducer Bins	None		

Other Testing Activities	
Payload Deployer Testing	
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	Instrumented operational equipment or mock equipment will be recovered. Ships will not be conducting test constantly for the duration of the allotted time. Any acoustic sources used during this activity would be de minimis and not quantitatively analyzed and, therefore, are not included under systems. When chaff is used, 36 concrete slugs per event are expended. Other components associated with chaff and flare use are not expected to float and would sink to the seafloor.

A.3.2.8.7 Semi-Stationary Equipment Testing

Other Testing Activities			
Semi-Stationary Equipment Testing			
Short Description	Semi-stationary equipment (e.g., hydrophones) is deployed to determine functionality.	**Typical Duration**	From 20 minutes to multiple days
Long Description	Semi-stationary equipment testing is performed from a fixed site, suspended over the side of a boat, moored to the bottom, suspended in the water column, or on the surface. Examples of semi-stationary equipment include moored hydrophones (i.e., devices to listen to underwater sound), line arrays (i.e., multiple hydrophones) deployed on the ocean bottom, acoustic countermeasures, a moored oceanographic sensor that moves vertically through the water column, and sonobuoys (i.e., expendable sonar systems). Some units produce sound in the water (e.g., acoustic countermeasures), while others only listen (e.g., passive sonobuoys, vector sensors that measure particle motion). Some tests could require deployment in an area that provides opportunistic data collection (e.g., placing a hydrophone near a shipping lane to collect shipping noise data), or with specific geographic or oceanographic requirements.		
Typical Components	**Platforms:** : In-water structures, moored platforms, shore based facility, support craft **Targets:** Air targets, electronic warfare targets, land targets, sub-surface targets, surface targets **Systems being Trained/Tested:** Air gun systems, acoustic countermeasures, sonar systems, underwater communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Naval Surface Warfare Center, Panama City Division Naval Undersea Warfare Center Division, Newport	**Inshore Waters/Pierside:** Newport, Rhode Island
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise Sonar and other transducers **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** In-water electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Acoustic countermeasures, sub-surface (mobile and stationary) targets, surface (mobile and stationary) targets	**Military Recoverable Material**	Air target (drone), sub-surface (mobile and stationary) targets, surface (mobile and stationary) targets

Other Testing Activities	
Semi-Stationary Equipment Testing	
Sonar and Other Transducer Bins	**Low-Frequency:** LF4 LF5 **Anti-Submarine Warfare:** ASW3 ASW4 **Swimmer Defense:** SD1 SD2 **Mid-Frequency:** MF9 MF10 **High-Frequency:** HF5 HF6 **Air Gun:** AG
In-Water Explosive Bins	None
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar Air guns **Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement
Assumptions Used for Analysis	None

A.3.2.8.8 Towed Equipment Testing

Other Testing Activities			
Towed Equipment Testing			
Short Description	Surface vessels or unmanned surface vehicles deploy and tow equipment to determine functionality of towed systems.	**Typical Duration**	Typically 2-8 hours
Long Description	Testing is conducted on equipment to evaluate hydrodynamic characteristics and control of a tow body, test fully functional items, or test a particular aspect of a system utilizing a mock-up of a functional item. A typical test operation for towed equipment testing involves a deployment, use, and recover scenario that requires range or commercial craft support. This equipment may be deployed from and towed by range craft or unmanned surface vehicles. The towed item may be underwater or floating on the surface. Equipment may be acoustically active or produce radio frequency transmissions.		
Typical Components	**Platforms:** Support craft, unmanned surface vehicles **Targets:** Sub-surface targets **Systems being Trained/Tested:** Sonar systems, underwater communication systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety Towed in-water device safety	**Typical Locations** **Range Complexes/Testing Ranges:** Naval Undersea Warfare Center Division, Newport	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Seafloor devices Military expended material **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Metals Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Physical disturbance and strike Airborne acoustics Accessibility	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Mine shapes (non-explosive), sub-surface target (stationary)	**Military Recoverable Material**	Mine shapes (non-explosive), sub-surface target (stationary)
Sonar and Other Transducer Bins	**Low-Frequency:** LF4	**Mid-Frequency:** MF9	**High-Frequency:** HF6
In-Water Explosive Bins	None		

Other Testing Activities		
Towed Equipment Testing		
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement Towed in-water devices
Assumptions Used for Analysis	None	

A.3.3 Office of Naval Research Testing Activities

A.3.3.1 Acoustic and Oceanographic Science and Technology

A.3.3.1.1 Acoustic and Oceanographic Research

<table>
<tr><th colspan="4">Acoustic and Oceanographic Science and Technology</th></tr>
<tr><th colspan="4">Acoustic and Oceanographic Research</th></tr>
<tr><td>Short Description</td><td>Research using active transmissions from sources deployed from ships, aircraft, and unmanned underwater vehicles. Research sources can be used as proxies for current and future Navy systems.</td><td colspan="2">Typical Duration
Up to 14 days</td></tr>
<tr><td>Long Description</td><td colspan="3">Active acoustic transmissions used for engineering tests of acoustic sources, validation of ocean acoustic models, tests of signal processing algorithms, and characterization of acoustic interactions with the ocean bottom, fish and ocean surface. Standard oceanographic research sensing (acoustic Doppler current profiler, fathometer-like systems) also to be employed.</td></tr>
<tr><td>Typical Components</td><td colspan="3">Platforms: Special mission ships, unmanned underwater vehicles, fixed-wing aircraft
Targets: Sub-surface targets
Systems being Trained/Tested: Air guns, sonar systems, sonobuoys, underwater communication systems, low-power lasers</td></tr>
<tr><td>Standard Operating Procedures
(Section 2.3.3)</td><td>Aircraft safety
Vessel safety
Unmanned aerial, surface, and subsurface vehicle safety</td><td colspan="2">Typical Locations
Range Complexes/Testing Ranges:
Gulf of Mexico
Northeast
Virginia Capes
Inshore Waters/Pierside:
None</td></tr>
<tr><td>Stressors to Biological Resources and Habitats</td><td>Acoustic:
Sonar and other transducers
Vessel noise
Aircraft noise

Explosives:
In-water explosives</td><td>Physical Disturbance and Strike:
Aircraft and aerial target strike
Vessel and in-water device strike
Military expended materials
Seafloor devices

Ingestion:
Military expended materials – other than munitions</td><td>Energy:
In-air electromagnetic devices

Entanglement:
Decelerators/parachutes
Wires and cables</td></tr>
<tr><td>Stressors to Physical Resources</td><td>Air Quality:
Criteria air pollutants</td><td colspan="2">Sediments and Water Quality:
Explosives
Chemicals
Metals
Other materials</td></tr>
<tr><td>Stressors to Human Resources</td><td>Cultural Resources:
Physical disturbance and strike
Explosives</td><td>Socioeconomic Resources:
Accessibility
Airborne acoustics
Physical disturbance and strike</td><td>Public Health and Safety:
Physical interactions
In-air energy
In-water energy</td></tr>
<tr><td>Military Expended Material</td><td>Ingestible Material:
Buoy (explosive) fragments, Decelerators/parachutes - Small

Non-Ingestible Material:
Sonobuoys (non-explosive), sonobuoy wires, expended bathythermograph, expended bathythermograph wires, anchor-other</td><td>Military Recoverable Material</td><td>Anchors – Other, subsurface targets (stationary)</td></tr>
</table>

Acoustic and Oceanographic Science and Technology				
Acoustic and Oceanographic Research				
Sonar and Other Transducer Bins	**Low-Frequency:** LF3 LF5 LF4	**Mid-Frequency:** MF8 MF9 **Anti-Submarine Warfare:** ASW2	**Air Gun:** AG **Broadband:** BB4	
In-Water Explosive Bins	E3			
Procedural Mitigation Measures	**Acoustic Stressors:** *(Section 5.3.2)* Active sonar Air guns		**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement **Explosive Stressors:** *(Section 5.3.3)* Explosive mine countermeasure and neutralization activities	
Assumptions Used for Analysis	None			

A.3.3.1.2 Emerging Mine Countermeasure Technology Research

Acoustic and Oceanographic Science and Technology			
Emerging Mine Countermeasure Technology Research			
Short Description	Test involves the use of broadband acoustic sources on unmanned underwater vehicles.	**Typical Duration** Up to 14 days	
Long Description	Mine countermeasure system testing on unmanned underwater vehicles to take place offshore and in coastal waters. Broadband acoustic sources on unmanned underwater vehicles will use downward directed acoustic transmissions to characterize the ocean bottom. Inert objects will be placed on the bottom to test system performance.		
Typical Components	**Platforms:** Special mission ships, unmanned underwater vehicles **Targets:** Mine shapes **Systems being Trained/Tested:** Sonar systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Jacksonville Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Sonar and other transducers Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material Seafloor device **Ingestion:** None	**Energy:** In-air electromagnetic devices **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Airborne acoustics Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-air energy In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Anchor - other	**Military Recoverable Material**	Mine shapes (non-explosive)
Sonar and Other Transducer Bins	**Broadband:** BB1 BB2		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	None		

A.3.3.1.3 Large Displacement Unmanned Underwater Vehicle Testing

Acoustic and Oceanographic Science and Technology			
Large Displacement Unmanned Undersea Vehicle Testing			
Short Description	Autonomy testing and environmental data collection with Large Displacement Unmanned Undersea Vehicles (Innovative Navy Prototype).	**Typical Duration** Up to 60 days per deployment	
Long Description	Large Displacement Unmanned Undersea Vehicle Innovative Navy Prototype (LDUUV INP) testing includes launch, autonomous transit (up to 60 days), environmental data collection (e.g., bathymetry, water column properties, ocean surface properties) and retrieval. LDUUV INP testing throughout the study area will include de minimis acoustic sources (modems, imaging sonars and fathometers) for safe navigation and data collection.		
Typical Components	**Platforms:** Unmanned underwater vehicles **Targets:** Sub-surface targets **Systems being Trained/Tested:** Undersea vehicles, environmental data collection systems		
Standard Operating Procedures *(Section 2.3.3)*	Vessel safety Unmanned aerial, surface, and subsurface vehicle safety	**Typical Locations** **Range Complexes/Testing Ranges:** Gulf of Mexico Jacksonville Navy Cherry Point Northeast Virginia Capes	**Inshore Waters/Pierside:** None
Stressors to Biological Resources and Habitats	**Acoustic:** Vessel noise **Explosives:** None	**Physical Disturbance and Strike:** Vessel and in-water device strike Military expended material **Ingestion:** None	**Energy:** None **Entanglement:** None
Stressors to Physical Resources	**Air Quality:** Criteria air pollutants	**Sediments and Water Quality:** Other materials	
Stressors to Human Resources	**Cultural Resources:** Physical disturbance and strike	**Socioeconomic Resources:** Accessibility Physical disturbance and strike	**Public Health and Safety:** Physical interactions In-water energy
Military Expended Material	**Ingestible Material:** None **Non-Ingestible Material:** Subsurface targets (stationary)	**Military Recoverable Material**	Subsurface targets (stationary)
Sonar and Other Transducer Bins	None		
In-Water Explosive Bins	None		
Procedural Mitigation Measures	**Physical Disturbance and Strike:** *(Section 5.3.4)* Vessel movement		
Assumptions Used for Analysis	Any acoustic sources used during this activity would be de minimis and not quantitatively analyzed and therefore are not included under systems.		

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APPENDIX B
Activity Stressor Matrices

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Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

This section does not contain figures.

List of Tables

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Table B-1: Stressors by Training Activity

	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressor	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
Atlantic Fleet Training Activity	*Sonar & Other Transducers*	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer [1]*	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals other than Explosives*	*Metals*	*Other Materials [2]*	*Explosives [4]*	*Physical Disturbance & Strikes [5]*	*Accessibility [6]*	*Airborne Acoustics [7]*	*Physical Disturbance and Strikes [5]*	*In-Water Energy [8]*	*In-Air Energy [9]*	*Physical Interactions [10]*
MAJOR TRAINING EXERCISES – LARGE INTEGRATED ANTI-SUBMARINE WARFARE																																	
Composite Training Unit Exercise	✓		✓	✓				✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
MAJOR TRAINING EXERCISES – MEDIUM INTEGRATED ANTI-SUBMARINE WARFARE																																	
Fleet Exercise / Sustainment Exercise	✓		✓	✓				✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
INTEGRATED/COORDINATED TRAINING – SMALL INTEGRATED ANTI-SUBMARINE WARFARE TRAINING																																	
Navy Undersea Warfare Training Assessment Course	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
Surface Warfare Advanced Tactical Training	✓		✓	✓				✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
INTEGRATED/COORDINATED TRAINING – MEDIUM COORDINATED ANTI-SUBMARINE WARFARE TRAINING																																	
Tactical Development Exercise	✓		✓	✓				✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
INTEGRATED/COORDINATED TRAINING – SMALL COORDINATED ANTI-SUBMARINE WARFARE TRAINING																																	
Amphibious Ready Group Marine Expeditionary Unit Exercise	✓		✓	✓				✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
Group Sail	✓		✓	✓				✓	✓		✓	✓	✓			✓	✓			✓	✓		✓	✓									
AIR WARFARE																																	
Air Combat Maneuver				✓					✓			✓									✓						✓	✓	✓	✓		✓	✓
Air Defense Exercise			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Gunnery Exercise Air-to-Air – Medium-Caliber				✓	✓				✓			✓	✓						✓		✓			✓									
Gunnery Exercise Surface-to-Air – Large-Caliber			✓	✓	✓				✓		✓	✓	✓							✓	✓			✓	✓								

Table B-1: Stressors by Training Activity (continued)

Atlantic Fleet Training Activity	*Biological Resources*																				*Physical Resources*					*Human Resources* [3]							
	Acoustic Stressors						*Explosive Stressor*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals other than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
Gunnery Exercise Surface-to-Air – Medium-Caliber			✓	✓	✓				✓		✓	✓	✓						✓	✓	✓			✓	✓								
Missile Exercise Air-to-Air			✓	✓	✓		✓		✓		✓	✓	✓				✓		✓	✓	✓	✓	✓	✓	✓								
Missile Exercise Man-Portable Air Defense System			✓	✓	✓		✓				✓	✓	✓						✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓
Missile Exercise Surface-to-Air			✓	✓	✓		✓		✓		✓	✓	✓				✓		✓	✓	✓	✓	✓	✓	✓								
AMPHIBIOUS WARFARE																																	
Amphibious Assault			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Amphibious Marine Expeditionary Unit Integration Exercise			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Amphibious Raid			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Amphibious Vehicle Maneuvers			✓								✓										✓						✓	✓		✓			✓
Humanitarian Assistance Operations			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Marine Expeditionary Unit Certification Exercise			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Naval Surface Fire Support Exercise – At Sea			✓		✓				✓		✓		✓								✓			✓									
Naval Surface Fire Support Exercise – Land-Based Target			✓		✓				✓		✓		✓								✓			✓			✓	✓	✓	✓		✓	✓
ANTI-SUBMARINE WARFARE																																	
Anti-Submarine Warfare Torpedo Exercise – Helicopter	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓								
Anti-Submarine Warfare Torpedo Exercise – Maritime Patrol Aircraft	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓								

Table B-1: Stressors by Training Activity (continued)

Atlantic Fleet Training Activity	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressor	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer [1]*	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals other than Explosives*	*Metals*	*Other Materials [2]*	*Explosives [4]*	*Physical Disturbance & Strikes [5]*	*Accessibility [6]*	*Airborne Acoustics [7]*	*Physical Disturbance and Strikes [5]*	*In-Water Energy [8]*	*In-Air Energy [9]*	*Physical Interactions [10]*
Anti-Submarine Warfare Torpedo Exercise – Ship	✓		✓	✓					✓		✓	✓	✓			✓				✓	✓		✓	✓	✓								
Anti-Submarine Warfare Torpedo Exercise – Submarine	✓		✓	✓							✓	✓	✓			✓					✓			✓									
Anti-Submarine Warfare Tracking Exercise – Helicopter	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓								
Anti-Submarine Warfare Tracking Exercise – Maritime Patrol Aircraft	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓								
Anti-Submarine Warfare Tracking Exercise – Ship	✓		✓						✓		✓		✓			✓	✓			✓	✓		✓	✓	✓								
Anti-Submarine Warfare Tracking Exercise – Submarine	✓		✓								✓		✓			✓								✓									
ELECTRONIC WARFARE																																	
Counter Targeting Chaff Exercise – Aircraft				✓					✓			✓	✓							✓	✓			✓	✓								
Counter Targeting Chaff Exercise – Ship			✓		✓				✓		✓		✓							✓	✓			✓	✓								
Counter Targeting Flare Exercise				✓					✓			✓	✓							✓	✓		✓		✓								
Electronic Warfare Operations			✓	✓					✓		✓	✓									✓							✓				✓	✓
High-Speed Anti-Radiation Missile Exercise			✓	✓	✓		✓		✓		✓	✓	✓						✓	✓	✓		✓	✓	✓								
EXPEDITIONARY WARFARE																																	
Dive and Salvage Operations			✓								✓			✓							✓						✓	✓		✓			✓
Maritime Security Operations-Anti-Swimmer Grenades			✓		✓		✓				✓		✓						✓		✓	✓	✓	✓		✓	✓	✓		✓	✓		✓
Personnel Insertion/Extraction – Air			✓	✓							✓	✓	✓								✓		✓	✓			✓	✓					✓

Table B-1: Stressors by Training Activity (continued)

Atlantic Fleet Training Activity	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressor	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
	Sonar & Other Transducers	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	Air Guns	Explosions	In-Water Electromagnetic Devices	In-Air Electromagnetic Devices	High-Energy Lasers	Vessel & In-water Device Strike	Aircraft & Aerial Target Strike	Military Expended Material	Seafloor Devices	Pile Driving	Wires & Cables	Decelerators / Parachutes	Biodegradable Polymer [1]	Military Expended Materials – Munitions	Military Expended Materials – Other than Munitions	Criteria Air Pollutants	Explosives and Explosive By-Products	Chemicals other than Explosives	Metals	Other Materials [2]	Explosives [4]	Physical Disturbance & Strikes [5]	Accessibility [6]	Airborne Acoustics [7]	Physical Disturbance and Strikes [5]	In-Water Energy [8]	In-Air Energy [9]	Physical Interactions [10]
Personnel Insertion/Extraction – Surface and Subsurface			✓		✓						✓		✓	✓					✓		✓			✓			✓	✓	✓	✓			✓
Personnel Insertion/Extraction Training – Swimmer/Diver			✓								✓										✓							✓		✓			✓
Underwater Construction Team Training			✓								✓			✓							✓							✓		✓			✓
MINE WARFARE																																	
Airborne Mine Countermeasure – Mine Detection	✓			✓				✓			✓	✓		✓							✓						✓	✓		✓	✓	✓	✓
Airborne Mine Countermeasure – Towed Mine Neutralization				✓				✓			✓	✓		✓							✓						✓	✓	✓	✓	✓		✓
Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection Exercise	✓		✓	✓	✓		✓	✓			✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Coordinated Unit Level Helicopter Airborne Mine Countermeasure Exercises	✓			✓				✓			✓	✓	✓	✓							✓			✓	✓		✓	✓	✓	✓	✓	✓	✓
Mine Countermeasures – Mine Neutralization – Remotely Operated Vehicles	✓		✓	✓			✓	✓	✓		✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mine Countermeasure – Ship Sonar	✓		✓					✓	✓		✓			✓							✓					✓	✓	✓	✓	✓	✓	✓	✓
Mine Laying				✓					✓			✓	✓	✓							✓			✓									
Mine Neutralization – Explosive Ordnance Disposal			✓				✓				✓		✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Underwater Mine Countermeasures Raise, Tow, Beach, and Exploitation Operations			✓								✓			✓							✓						✓	✓	✓	✓			✓

Table B-1: Stressors by Training Activity (continued)

Atlantic Fleet Training Activity	*Biological Resources*																				*Physical Resources*					*Human Resources* [3]							
	Acoustic Stressors						*Explosive Stressor*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals other than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
SURFACE WARFARE																																	
Bombing Exercise (Air-to-Surface)			✓	✓	✓		✓		✓		✓	✓	✓						✓	✓	✓	✓	✓	✓	✓								
Fast Attack Craft & Fast Inshore Attack Craft			✓	✓	✓				✓		✓	✓	✓						✓		✓			✓			✓	✓	✓	✓		✓	✓
Gunnery Exercise Air-to-Surface – Medium-Caliber			✓	✓	✓				✓		✓	✓	✓						✓	✓	✓		✓	✓	✓								
Gunnery Exercise Air-to-Surface – Small-Caliber			✓	✓	✓				✓		✓	✓	✓						✓	✓	✓			✓	✓		✓	✓	✓	✓		✓	✓
Gunnery Exercise Surface-to-Surface Boat – Medium-Caliber			✓		✓		✓				✓		✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Gunnery Exercise Surface-to-Surface Boat – Small-Caliber			✓		✓						✓		✓						✓	✓	✓			✓	✓		✓	✓	✓	✓			✓
Gunnery Exercise Surface-to-Surface Ship –Large Caliber			✓		✓		✓		✓		✓		✓						✓	✓	✓	✓	✓	✓	✓								
Gunnery Exercise Surface-to-Surface Ship – Medium			✓		✓		✓		✓		✓		✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gunnery Exercise Surface-to-Surface Ship – Small-Caliber			✓		✓				✓		✓		✓						✓	✓	✓			✓	✓		✓	✓	✓	✓		✓	✓
Integrated Live Fire			✓	✓	✓		✓		✓		✓	✓	✓						✓	✓	✓	✓	✓	✓	✓								
Laser Targeting - Aircraft			✓	✓					✓		✓	✓								✓	✓			✓	✓								
Laser Targeting – Ship			✓	✓					✓	✓	✓	✓	✓							✓	✓												
Maritime Security Operations			✓	✓	✓				✓		✓	✓	✓						✓	✓	✓			✓	✓		✓	✓	✓	✓	✓		✓
Missile Exercise Air-to-Surface			✓	✓	✓		✓		✓		✓	✓	✓						✓	✓	✓	✓	✓	✓	✓								

Table B-1: Stressors by Training Activity (continued)

Atlantic Fleet Training Activity	*Biological Resources*																				*Physical Resources*					*Human Resources* [3]							
	Acoustic Stressors						*Explosive Stressor*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals other than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
Missile Exercise Air-to-Surface Rocket			✓	✓	✓		✓		✓		✓	✓	✓						✓	✓	✓	✓	✓	✓	✓								
Missile Exercise Surface-to-Surface			✓		✓		✓		✓		✓	✓	✓						✓	✓	✓	✓	✓	✓	✓								
Sinking Exercise	✓		✓	✓	✓		✓		✓		✓	✓	✓			✓			✓	✓	✓	✓	✓	✓	✓								
OTHER TRAINING EXERCISES																																	
Elevated Causeway System		✓	✓								✓				✓						✓						✓	✓	✓	✓	✓	✓	✓
Precision Anchoring			✓						✓		✓			✓							✓						✓	✓	✓	✓		✓	✓
Search and Rescue			✓	✓					✓		✓	✓	✓								✓		✓	✓			✓	✓	✓	✓		✓	✓
Submarine Navigation	✓		✓								✓																✓	✓	✓	✓	✓		✓
Submarine Sonar Maintenance and System Checks	✓		✓								✓																				✓		
Submarine Under Ice Certification	✓		✓								✓		✓			✓					✓			✓									
Surface Ship Object Detection	✓		✓						✓		✓			✓							✓						✓	✓	✓	✓	✓	✓	✓
Surface Ship Sonar Maintenance and Systems Checks	✓		✓						✓		✓										✓										✓		

Table B-1: Stressors by Training Activity (continued)

	Biological Resources																				*Physical Resources*					*Human Resources* [3]							
	Acoustic Stressors						*Explosive Stressor*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
Atlantic Fleet Training Activity	*Sonar & Other Transducers*	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals other than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
Waterborne Training			✓								✓		✓						✓		✓			✓			✓	✓	✓	✓			✓

[1] Testing Activities Only
[2] Other Materials include marine markers and flares, chaff, towed and stationary targets, and miscellaneous components of other expended objects
[3] Area of interest is U.S. Territorial Waters (seaward of the mean high water line to 12 nautical miles and any inshore waters)
[4] Vibration and shock waves from underwater explosions.
[5] Physical disturbance and strike stressors resulting from aircraft, vessels and in-water devices, and military expended materials in U.S. territorial waters (seaward of the mean high water line to 12 nautical miles).
[6] Availability of access on the ocean and in the air
[7] Loud Noises from weapons firing, aircraft & vessel noise, and pile driving.
[8] Active sonar, underwater explosions, air guns, vessel movements, mine warfare training devices, and unmanned underwater systems
[9] Sources of electromagnetic energy and lasers
[10] Interaction of Navy or Marine Corps aircraft, vessels, and equipment with general public
Note: A check indicates events that take place for Alternative 1 and Alternative 2.

Table B-2: Stressors by Testing Activity

Atlantic Fleet Testing Activity	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressors	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
	Sonar & Other Transducers	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	Air Guns	Explosions	In-Water Electromagnetic Devices	In-Air Electromagnetic Devices	High-Energy Lasers	Vessel & In-water Device Strike	Aircraft & Aerial Target Strike	Military Expended Material	Seafloor Devices	Pile Driving	Wires & Cables	Decelerators / Parachutes	Biodegradable Polymer [1]	Military Expended Materials – Munitions	Military Expended Materials – Other than Munitions	Criteria Air Pollutants	Explosives and Explosive By-Products	Chemicals Other Than Explosives	Metals	Other Materials [2]	Explosives [4]	Physical Disturbance & Strikes [5]	Accessibility [6]	Airborne Acoustics [7]	Physical Disturbance and Strikes [5]	In-Water Energy [8]	In-Air Energy [9]	Physical Interactions [10]
MAJOR TRAINING EXERCISES – AIR WARFARE																																	
Air Combat Maneuver Test				✓					✓			✓								✓	✓			✓	✓		✓	✓	✓	✓		✓	✓
Air Platform-Vehicle Test				✓					✓			✓	✓							✓	✓			✓	✓		✓	✓	✓	✓		✓	✓
Air Platform Weapons Integration Test				✓	✓				✓			✓	✓								✓			✓	✓		✓	✓	✓	✓		✓	✓
Air to Air Weapons System Test				✓	✓				✓			✓	✓				✓				✓			✓	✓		✓	✓	✓	✓		✓	✓
Air to Air Gunnery Test – Medium-Caliber				✓	✓				✓			✓	✓						✓		✓			✓									
Air to Air Missile Test				✓	✓				✓			✓	✓				✓				✓			✓			✓	✓	✓	✓		✓	✓
Intelligence, Surveillance, and Reconnaissance Test				✓					✓			✓									✓							✓	✓	✓		✓	✓
Anti-Submarine Warfare Torpedo Test	✓			✓	✓				✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Anti-Submarine Tracking Test – Helicopter	✓			✓			✓		✓		✓	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Anti-Submarine Warfare Tracking Test – Maritime Patrol Aircraft	✓			✓			✓		✓		✓	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kilo Dip	✓			✓					✓			✓									✓							✓	✓	✓	✓	✓	✓
Sonobuoy Lot Acceptance Test	✓		✓	✓			✓		✓		✓	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ELECTRONIC WARFARE																																	
Chaff Test				✓					✓			✓	✓							✓	✓			✓	✓		✓	✓	✓	✓		✓	✓

Table B-2: Stressors by Testing Activity (continued)

Atlantic Fleet Testing Activity	*Biological Resources*																				*Physical Resources*					*Human Resources* [3]							
	Acoustic Stressors						*Explosive Stressors*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals Other Than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
Radar and Other System Testing			✓	✓	✓		✓	✓	✓	✓	✓	✓	✓						✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓
Electronic System Evaluation				✓					✓			✓									✓							✓	✓	✓		✓	✓
Flare Test				✓					✓			✓	✓							✓	✓				✓		✓	✓	✓	✓		✓	✓
ANTI-SUBMARINE WARFARE																																	
Anti-Submarine Warfare Mission Package Testing	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
At-Sea Sonar Testing	✓		✓					✓	✓		✓		✓			✓	✓				✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Countermeasure Testing	✓		✓						✓		✓		✓			✓	✓	✓		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Pierside Sonar Testing	✓																														✓		
Submarine Sonar Testing/Maintenance	✓										✓										✓							✓		✓	✓		✓
Surface Ship Sonar Testing/Maintenance	✓		✓						✓		✓										✓							✓	✓	✓	✓	✓	✓
Torpedo (Explosive) Testing	✓		✓	✓			✓		✓		✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Torpedo (Non-Explosive Testing)	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
MINE WARFARE																																	
Airborne Dipping Sonar Minehunting Test	✓			✓					✓			✓		✓							✓						✓	✓	✓	✓	✓	✓	✓
Airborne Laser Based Mine Detection System Test				✓					✓			✓		✓													✓	✓	✓	✓		✓	✓
Airborne Mine Neutralization System Test			✓	✓			✓		✓		✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table B-2: Stressors by Testing Activity (continued)

Atlantic Fleet Testing Activity	*Biological Resources*																				*Physical Resources*					*Human Resources* [3]							
	Acoustic Stressors						*Explosive Stressors*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals Other Than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
Airborne Sonobuoy Minehunting Test	✓			✓					✓			✓	✓	✓		✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Mine Laying Test				✓					✓			✓	✓								✓			✓			✓	✓	✓	✓		✓	✓
Mine Countermeasure and Neutralization Testing	✓		✓	✓			✓	✓	✓		✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mine Countermeasure Mission Package Testing	✓		✓	✓			✓		✓		✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mine Detection and Classification Testing	✓		✓	✓				✓	✓		✓	✓		✓							✓						✓	✓	✓	✓	✓	✓	✓
SURFACE WARFARE																																	
Air-to-Surface Bombing Test				✓			✓		✓			✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air-to-Surface Gunnery Test				✓	✓		✓		✓			✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air-to-Surface Missile Test				✓	✓		✓		✓			✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High Energy Laser Weapons Test				✓					✓	✓		✓	✓							✓	✓			✓	✓		✓	✓	✓	✓		✓	✓
Laser Targeting Test				✓					✓			✓	✓								✓			✓	✓		✓	✓	✓	✓		✓	✓
Rocket Test				✓	✓		✓		✓			✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gun Testing – Large-Caliber			✓		✓		✓		✓		✓		✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gun Testing – Medium-Caliber			✓		✓		✓		✓		✓		✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gun Testing – Small-Caliber			✓		✓				✓		✓		✓						✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓

Table B-2: Stressors by Testing Activity (continued)

Atlantic Fleet Testing Activity	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressors	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
	Sonar & Other Transducers	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	Air Guns	Explosions	In-Water Electromagnetic Devices	In-Air Electromagnetic Devices	High-Energy Lasers	Vessel & In-water Device Strike	Aircraft & Aerial Target Strike	Military Expended Material	Seafloor Devices	Pile Driving	Wires & Cables	Decelerators / Parachutes	Biodegradable Polymer [1]	Military Expended Materials – Munitions	Military Expended Materials – Other than Munitions	Criteria Air Pollutants	Explosives and Explosive By-Products	Chemicals Other Than Explosives	Metals	Other Materials [2]	Explosives [4]	Physical Disturbance & Strikes [5]	Accessibility [6]	Airborne Acoustics [7]	Physical Disturbance and Strikes [5]	In-Water Energy [8]	In-Air Energy [9]	Physical Interactions [10]
Kinetic Energy Weapon Testing			✓		✓		✓		✓		✓	✓	✓						✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓
Missile and Rocket Testing			✓		✓		✓		✓		✓	✓	✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
UNMANNED SYSTEMS																																	
Underwater Search, Deployment, and Recovery											✓			✓							✓						✓	✓		✓	✓		✓
Unmanned Aerial System Testing			✓						✓		✓	✓	✓							✓	✓			✓	✓		✓	✓	✓	✓	✓		✓
Unmanned Surface Vehicle System Testing			✓					✓	✓		✓										✓							✓	✓	✓	✓	✓	✓
Unmanned Underwater Vehicle Testing	✓		✓				✓		✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VESSEL EVALUATION																																	
Aircraft Carrier Sea Trials – Propulsion Testing			✓						✓		✓										✓							✓	✓	✓	✓	✓	✓
Air Defense Testing			✓		✓		✓		✓		✓	✓	✓						✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓
Hydrodynamic and Maneuverability Testing			✓								✓																	✓		✓	✓		✓
In-Port Maintenance Testing									✓																						✓	✓	
Large Ship Shock Trial			✓	✓			✓		✓		✓	✓	✓							✓	✓	✓	✓		✓								
Propulsion Testing			✓						✓		✓										✓							✓	✓	✓	✓	✓	✓
Signature Analysis Operations	✓		✓						✓		✓		✓	✓		✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Small Ship Shock Trial			✓	✓			✓		✓		✓	✓	✓							✓	✓	✓	✓		✓								

Table B-2: Stressors by Testing Activity (continued)

Atlantic Fleet Testing Activity	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressors	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
	Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer [1]*	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals Other Than Explosives*	*Metals*	*Other Materials [2]*	*Explosives [4]*	*Physical Disturbance & Strikes [5]*	*Accessibility [6]*	*Airborne Acoustics [7]*	*Physical Disturbance and Strikes [5]*	*In-Water Energy [8]*	*In-Air Energy [9]*	*Physical Interactions [10]*
Submarine Sea Trials - Propulsion Testing			✓								✓																	✓		✓	✓		✓
Submarine Sea Trials - Weapons Testing	✓		✓								✓		✓			✓							✓	✓	✓		✓	✓		✓	✓		✓
Surface Warfare Testing			✓		✓		✓		✓		✓		✓						✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total Ship Survivability Trails			✓						✓		✓										✓							✓	✓	✓	✓	✓	✓
Undersea Warfare Testing	✓		✓	✓					✓		✓	✓	✓			✓	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Vessel Signature Evaluation	✓		✓	✓				✓	✓		✓	✓									✓							✓	✓	✓	✓	✓	✓
OTHER TESTING ACTIVITIES																																	
Acoustic and Oceanographic Research (NAVAIR)			✓	✓				✓	✓		✓	✓	✓								✓				✓		✓	✓	✓	✓		✓	✓
Acoustic and Oceanographic Research (ONR)	✓		✓	✓			✓		✓		✓	✓	✓	✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air Platform Shipboard Integrate Test				✓					✓			✓									✓							✓	✓	✓		✓	✓
Maritime Security			✓	✓					✓		✓	✓									✓						✓	✓	✓	✓		✓	✓
Shipboard Electronic Systems Evaluation				✓					✓			✓									✓							✓	✓	✓		✓	✓
Undersea Range System Test	✓		✓						✓		✓										✓												
Acoustic Component Testing	✓		✓								✓	✓									✓							✓	✓	✓	✓		✓
Chemical and Biological Simulant Testing			✓	✓					✓		✓	✓									✓		✓					✓	✓	✓	✓	✓	✓

Table B-2: Stressors by Testing Activity (continued)

Atlantic Fleet Testing Activity	Biological Resources																				Physical Resources					Human Resources [3]							
	Acoustic Stressors						Explosive Stressors	Energy Stressors			Physical Disturbance and Strike Stressors					Entanglement Stressors			Ingestion Stressors		Air Quality Stressors	Sediment Water Quality Stressors				Cultural Resource Stressors		Socioeconomic Stressors			Public Health and Safety Stressors		
	Sonar & Other Transducers	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	Air Guns	Explosions	In-Water Electromagnetic Devices	In-Air Electromagnetic Devices	High-Energy Lasers	Vessel & In-water Device Strike	Aircraft & Aerial Target Strike	Military Expended Material	Seafloor Devices	Pile Driving	Wires & Cables	Decelerators / Parachutes	Biodegradable Polymer [1]	Military Expended Materials – Munitions	Military Expended Materials – Other than Munitions	Criteria Air Pollutants	Explosives and Explosive By-Products	Chemicals Other Than Explosives	Metals	Other Materials [2]	Explosives [4]	Physical Disturbance & Strikes [5]	Accessibility [6]	Airborne Acoustics [7]	Physical Disturbance and Strikes [5]	In-Water Energy [8]	In-Air Energy [9]	Physical Interactions [10]
Insertion/Extraction	✓		✓								✓																	✓		✓	✓		✓
Line Charge Testing			✓				✓				✓		✓							✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓
Non-Acoustic Component Testing			✓	✓					✓		✓	✓									✓							✓	✓	✓	✓	✓	✓
Payload Deployer Testing			✓						✓		✓		✓			✓				✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓
Semi-Stationary Equipment Testing	✓		✓					✓			✓		✓								✓			✓	✓		✓	✓	✓	✓	✓	✓	✓
Towed Equipment Testing	✓		✓								✓		✓	✓							✓			✓	✓		✓	✓	✓	✓	✓		✓
Emerging Mine Countermeasure Technology Research	✓		✓						✓		✓		✓	✓							✓				✓		✓	✓	✓	✓	✓	✓	✓
Large Displacement Unmanned Underwater Vehicle Testing			✓								✓		✓								✓				✓		✓	✓		✓	✓		✓

[1] Testing Activities Only
[2] Other Materials include marine markers and flares, chaff, towed and stationary targets, and miscellaneous components of other expended objects
[3] Area of interest is U.S. Territorial Waters (seaward of the mean high water line to 12 nautical miles and any inshore waters)
[4] Vibration and shock waves from underwater explosions.
[5] Physical disturbance and strike stressors resulting from aircraft, vessels and in-water devices, and military expended materials in U.S. territorial waters (seaward of the mean high water line to 12 nautical miles).
[6] Availability of access on the ocean and in the air
[7] Loud Noises from weapons firing, aircraft & vessel noise, and pile driving.
[8] Active sonar, underwater explosions, air guns, vessel movements, mine warfare training devices, and unmanned underwater systems
[9] Sources of electromagnetic energy and lasers
[10] Interaction of Navy or Marine Corps aircraft, vessels, and equipment with general public
Note: A check indicates events that take place for Alternative 1 and Alternative 2.

Table B-3: Stressors by Resource

Atlantic Fleet Training Activity		*Biological Resources*																				*Physical Resources*					*Human Resources* [3]							
		Acoustic Stressors						*Explosive Stressors*	*Energy Stressors*			*Physical Disturbance and Strike Stressors*					*Entanglement Stressors*			*Ingestion Stressors*		*Air Quality Stressors*	*Sediment Water Quality Stressors*				*Cultural Resource Stressors*		*Socioeconomic Stressors*			*Public Health and Safety Stressors*		
		Sonar & Other Transducers	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Air Guns*	*Explosions*	*In-Water Electromagnetic Devices*	*In-Air Electromagnetic Devices*	*High-Energy Lasers*	*Vessel & In-water Device Strike*	*Aircraft & Aerial Target Strike*	*Military Expended Material*	*Seafloor Devices*	*Pile Driving*	*Wires & Cables*	*Decelerators / Parachutes*	*Biodegradable Polymer* [1]	*Military Expended Materials – Munitions*	*Military Expended Materials – Other than Munitions*	*Criteria Air Pollutants*	*Explosives and Explosive By-Products*	*Chemicals Other Than Explosives*	*Metals*	*Other Materials* [2]	*Explosives* [4]	*Physical Disturbance & Strikes* [5]	*Accessibility* [6]	*Airborne Acoustics* [7]	*Physical Disturbance and Strikes* [5]	*In-Water Energy* [8]	*In-Air Energy* [9]	*Physical Interactions* [10]
Physical	Air Quality																					✓												
	Sediments and Water Quality																						✓	✓	✓	✓								
Biological	Vegetation							✓				✓		✓	✓								✓	✓	✓	✓								
	Invertebrates	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓								
	Habitats							✓				✓		✓	✓	✓																		
	Fishes	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓								
	Marine Mammals	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓								
	Reptiles	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓								
	Birds and Bats	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓								
Human	Cultural Resources																										✓	✓						
	Socioeconomic																												✓	✓	✓			
	Public Health and Safety																															✓	✓	✓

[1] Testing Activities Only
[2] Other Materials include marine markers and flares, chaff, towed and stationary targets, and miscellaneous components of other expended objects
[3] Area of interest is U.S. Territorial Waters (seaward of the mean high water line to 12 nautical miles and any inshore waters)
[4] Vibration and shock waves from underwater explosions.
[5] Physical disturbance and strike stressors resulting from aircraft, vessels and in-water devices, and military expended materials in U.S. territorial waters (seaward of the mean high water line to 12 nautical miles).
[6] Availability of access on the ocean and in the air
[7] Loud Noises from weapons firing, aircraft & vessel noise, and pile driving.
[8] Active sonar, underwater explosions, air guns, vessel movements, mine warfare training devices, and unmanned underwater systems
[9] Sources of electromagnetic energy and lasers
[10] Interaction of Navy or Marine Corps aircraft, vessels, and equipment with general public
Note: A check indicates events that take place for Alternative 1 and Alternative 2.

APPENDIX C
Air Quality Emissions Calculations and Record of Non-Applicability

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Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

APPENDIX C AIR QUALITY EMISSIONS CALCULATIONS AND RECORD OF NON-APPLICABILITY

This appendix discusses emission factor development and calculations including assumptions employed in the analyses presented in the Air Quality section of Chapter 3 (Section 3.1).

C.1 AIR QUALITY EXAMPLE CALCULATIONS

C.1.1 SURFACE ACTIVITIES EMISSIONS

Surface activities consist of activities associated with boat and vessel traffic. Fleet training activities incorporate a variety of marine vessels including cruisers, destroyers, frigates, carriers, riverine vessels, and rigid hull inflatable boats. Larger vessels also have generators operating onboard to provide electricity for non-propulsion functions. Each of these vessels incorporates different propulsion methods such as marine outboard engines, diesel engines, and gas turbines. Calculations are based on the combustion of fossil fuels (primarily diesel) in these engines and the time they run.

C.1.1.1.1 Marine Outboard Engines

The U.S. Environmental Protection Agency (USEPA) has published emissions factors for air pollutants produced by several types of two-stroke and four-stroke outboard engines. These engines are operated on a variety of small boats and vessels involved in nearshore training and testing activities. Emission factors were obtained from USEPA NONROAD documentation for Compression Ignition and Spark Ignition engines.

Emissions estimates for surface craft utilizing outboard engines were calculated using USEPA NONROAD factors multiplied by the engine horsepower and hours of operation.

Emissions = HP×HR/YR×EF×ENG
Where:
Emissions = Surface craft Emissions (pound per year)
HP = Horsepower (reflective of a particular load factor/engine power setting)
HR/YR = Hours per year
EF = Emission factor for specific engine type ENG = Number of engine

To determine the entire project emissions, a calculation was conducted for each surface vessel type and for each pollutant and converted to tons, then compared to the baseline Study Area emissions. The baseline is defined as the training and testing identified as the Preferred Alternative in the Atlantic Fleet Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement released in August 2013.These values were summed according to the appropriate pollutant to provide the cumulative emissions associated with surface vessel emissions activities.

C.1.1.1.2 Diesel Engines

Large vessel emissions were calculated in a similar fashion using emission factors from the Naval Sea Systems Command Navy and Military Sealift Command Marine Engine Fuel Consumption and Emission Calculator for the propulsion system and the supplemental ship service generator(s).

Diesel engine emission factors were multiplied by the engine horsepower and annual hours of operation to calculate the pounds of pollutant emissions per year. This value was then converted to a tons per year value for comparison with the Study Area total summed emissions on an individual pollutant basis.

C.1.2 Air Activities Emissions

Fleet training and Naval Air Systems Command testing consists of various activities associated with airplanes or helicopters. Aircraft activities of concern are those that occur from ground level up to 3,000 feet (ft.) above ground level. The 3,000 ft. above ground level ceiling is the default atmospheric mixing height above which any pollutant generated would not contribute to increased pollutant concentrations at ground level (known as the mixing zone). All pollutant emissions from aircraft generated greater than 3,000 ft. above ground level are excluded from this analysis. The pollutant emission rate is a function of the engine's operating mode, the fuel flow rate, and the engine's overall efficiency. Emissions for one complete flight for a particular aircraft are calculated by knowing the specific engine pollutant emission factors for each mode of operation.

For this EIS/OEIS, emission factors for most military engines were obtained from Navy's Aircraft Environmental Support Office (AESO) memoranda. For those aircraft for which engine data from AESO was unavailable, applicable data from other reputable data sources was used. Emissions factors vary depending on engine power mode, time in each mode, and fuel flow. Using these data, as well as information on hours of cruise time and number of landing/takeoff activities on a vessel, pollutant emissions for each aircraft and activity were calculated by applying the equation below.

Emissions = TIM×FF×EF×ENG×CF
Where:
Emissions = Aircraft Emissions (lb. per activity) (for EF in lb./1000 gallon fuel) TIM = Time-in-mode at a specified power setting (hr/activity).
FF = Fuel flow at a specified power setting (gallons/hr/engine)
EF = Emission factor for specific engine type and power setting (lb./1000 gallons of fuel used) ENG = Number of engines on aircraft

As the equation indicates, emissions were estimated by first calculating total fuel used in each of the different modes with the appropriate emission factor.

C.1.3 Munitions Emissions

Available emissions factors (AP-42, Compilation of Air Pollutant Emission Factors) were utilized. These factors were then multiplied by the net weight of the explosive (or a conversion factor for pounds per item) and the number of times that the munition was used during a designated time frame. This calculation provided annual pounds per year of emissions, which were converted to tons per year for comparison purposes.

Emissions = EXP/YR×EF
Where:
Emissions = Ordnance Emissions (lb. per year)
EXP/YR = Explosives, propellants, and pyrotechnics used per year EF = Emissions factor

C.1.4 Record of Non-Applicability

A Record of Non-Applicability For Clean Air Act Conformity has been prepared in accordance with the Navy Guidance for Compliance with the Clean Air Act General Conformity Rule (30 July 2013) and is included In Section C.2.

C.1.5 EMISSIONS ESTIMATES TABLES

The following tables contain data used for the emissions calculations for vessels, aircraft, and munitions, respectively. These tables were converted from excel spreadsheets.

Tab A: Introduction

Appendix Organization

Tab A	Appendix C Introduction
Tab B	Baseline (Preferred Alternative from V2)
Tab C	Emissions Summary
Tab D	Ship Emissions
Tab E	Training in State Waters
Tab F	Inland Water Training Events and Locations
Tab G	Aircraft Emissions
Tab H	Munition Emissions
Tab I	Ship and Boat Emission Factors
Tab J	Munition Emission Factors
Tab K	Aircraft Engine Emissions Factors and Profiles
Tab L	Aircraft Activity - Testing
Tab M	Aircraft Activity - Training
Tab N	Aircraft Activity by Region
Tab O	Aircraft Engine Emission Factor Sources
Tab P	Munition Activity Data
Tab Q	Baseline (V2 Preferred Alternative) Munition Summary
Tab R	Assumptions/References

Data Organization

Acronyms

A/C	aircraft
AESO	Aircraft Environmental Support Office
CO	Carbon monoxide
gal	gallon
GPH	gallons per hour
HC	hydrocarbons
hp	horsepower
hr	hour
lb	pound
NM	nautical mile
NO_x	Nitrogen oxides
PM	Particulate matter
SO_x	Sulfur dioxide
VOC	Volatile organic compounds
yr	year

Data Organization

Designation [a]	***Relationship to EPA Region (coastal states)***	
Northeast OPAREA	Region 1:	Maine, New Hampshire, Massachusets, Rhode Island and Connecticut
	Region 2:	New York and New Jersey
VACAPES OPAREA	Region 3:	Delaware, Virginia
Cherry Pt OPAREA	Region 4:	North Carolina, South Carolina, Georgia
JAX OPAREA	Region 4:	Florida
Key West OPAREA	Region 4:	Florida
GOMEX OPAREA	Region 4:	Florida and Alabama
	Region 6:	Louisiana and Texas
Outside Range Complexes	Other locations within the Study Area that are not in the OPAREA boundaries	

[a] the OPAREA designation includes adjacent state waters. These are also separately delineated in the calculations.

Tab B: Baseline (Preferred Alternative in the Atlantic Fleet Forces Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statementvreleased in August 2013)

Tab B Table 1. Estimated Annual Criteria Air Pollutant Emissions from Training, Alternative 2

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Northeast Range Complex						
State waters (0-3 nm)						
Aircraft	0.04	0.17	0.01	0.01	0.04	0.04
Vessel	0.24	0.25	0.10	0.05	0.01	0.01
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.27**	**0.42**	**0.11**	**0.06**	**0.05**	**0.05**
Waters of the U.S. (3-12 nm)						
Aircraft	0.02	0.07	0.00	0.00	0.02	0.02
Vessel	0.52	0.63	0.28	0.12	0.01	0.01
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.54**	**0.71**	**0.29**	**0.12**	**0.03**	**0.03**
International waters (>12 nm)						
Aircraft	0.76	3.13	0.16	0.15	0.76	0.76
Vessel	5.84	6.38	0.51	1.28	0.14	0.14
Ordnance	0.04	0.00	0.00	0.00	0.03	0.00
Total	**6.64**	**9.50**	**0.68**	**1.43**	**0.92**	**0.90**
Total for Northeast Range Complex						
Aircraft	0.81	3.37	0.17	0.16	0.81	0.81
Vessel	6.60	7.26	0.90	1.45	0.16	0.16
Ordnance	0.04	0.00	0.00	0.00	0.03	0.01
Total	**7.46**	**10.63**	**1.07**	**1.61**	**1.00**	**0.98**
				Percent In-State		**0.04**
Virginia Capes Range Complex						
State waters (0-3 nm)						
Aircraft	24.43	25.29	2.16	1.58	8.27	8.27
Vessel	1.49	30.89	2.92	3.37	0.20	0.20
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**25.92**	**56.18**	**5.08**	**4.94**	**8.47**	**8.47**
Waters of the U.S. (3-12 nm)						
Aircraft	1.98	2.14	0.18	0.13	0.69	0.69
Vessel	124.12	81.21	19.50	25.76	2.35	2.35
Ordnance	2.27	0.09	0.00	0.00	0.13	0.09
Total	**128.38**	**83.45**	**19.68**	**25.89**	**3.17**	**3.13**
International waters (>12 nm)						
Aircraft	22.81	52.66	2.70	2.19	13.35	13.35
Vessel	593.25	390.35	56.02	182.75	16.80	16.80
Ordnance	20.47	0.82	0.00	0.00	1.21	0.79
Total	**636.53**	**443.84**	**58.72**	**184.94**	**31.37**	**30.94**

Tab B Table 1. Estimated Annual Criteria Air Pollutant Emissions from Training, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Total for Virginia Capes Range Complex						
Aircraft	49.22	80.10	5.04	3.90	22.31	22.31
Vessel	718.86	502.46	78.43	211.87	19.36	19.36
Ordnance	22.75	0.91	0.00	0.00	1.35	0.87
Total	**790.82**	**583.47**	**83.48**	**215.77**	**43.01**	**42.54**
				Percent In-State		0.06
Cherry Point Range Complex						
State waters (0-3 nm)						
Aircraft	5.74	5.82	0.52	0.36	1.85	1.85
Vessel	16.35	34.36	3.46	35.46	3.09	3.09
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**22.09**	**40.18**	**3.98**	**35.82**	**4.94**	**4.94**
Waters of the U.S. (3-12 nm)						
Aircraft	0.86	0.89	0.07	0.05	0.30	0.30
Vessel	41.97	46.86	4.88	39.63	3.48	3.48
Ordnance	0.56	0.01	0.00	0.00	0.01	0.01
Total	**43.39**	**47.76**	**4.95**	**39.69**	**3.79**	**3.78**
International waters (>12 nm)						
Aircraft	19.72	187.44	2.59	5.56	42.85	42.85
Vessel	858.49	472.22	72.86	191.08	14.90	14.90
Ordnance	5.00	0.13	0.00	0.00	0.13	0.07
Total	**883.21**	**659.79**	**75.44**	**196.63**	**57.88**	**57.82**
Total for Cherry Point Range Complex						
Aircraft	26.32	194.15	3.18	5.97	45.00	45.00
Vessel	916.81	553.44	81.20	266.17	21.47	21.47
Ordnance	5.56	0.15	0.00	0.00	0.14	0.07
Total	**948.69**	**747.73**	**84.37**	**272.14**	**66.61**	**66.54**
				Percent In-State		0.05
Jacksonville Range Complex						
State waters (0-3 nm)						
Aircraft	5.07	5.97	0.48	0.36	1.86	1.86
Vessel	4.79	9.78	3.02	6.38	0.56	0.56
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**9.85**	**15.76**	**3.49**	**6.74**	**2.41**	**2.41**
Waters of the U.S. (3-12 nm)						
Aircraft	1.98	2.36	0.19	0.14	0.74	0.74
Vessel	73.59	50.01	14.31	19.36	1.68	1.68
Ordnance	1.24	0.05	0.00	0.00	0.13	0.08
Total	**76.81**	**52.43**	**14.50**	**19.50**	**2.55**	**2.49**

Tab B Table 1. Estimated Annual Criteria Air Pollutant Emissions from Training, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
International waters (>12 nm)						
Aircraft	31.55	214.14	4.32	6.83	49.42	49.42
Vessel	758.55	440.02	65.39	182.69	15.09	15.09
Ordnance	11.18	0.49	0.00	0.00	1.15	0.68
Total	**801.28**	**654.64**	**69.72**	**189.53**	**65.66**	**65.19**
Total for Jacksonville Range Complex						
Aircraft	38.60	222.48	4.99	7.33	52.02	52.02
Vessel	836.93	499.81	82.72	208.44	17.33	17.33
Ordnance	12.42	0.54	0.00	0.00	1.28	0.75
Total	**887.95**	**722.83**	**87.71**	**215.77**	**70.62**	**70.10**
				Percent In-State		0.02
Key West Range Complex						
State waters (0-3 nm)						
Aircraft	0.00	0.00	0.00	0.00	0.00	0.00
Vessel	0.01	0.34	0.00	0.04	0.00	0.00
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.01**	**0.34**	**0.00**	**0.04**	**0.00**	**0.00**
Waters of the U.S. (3-12 nm)						
Aircraft	0.00	0.00	0.00	0.00	0.00	0.00
Vessel	0.00	0.00	0.00	0.00	0.00	0.00
Ordnance	0.09	0.00	0.00	0.00	0.00	0.00
Total	**0.09**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
International waters (>12 nm)						
Aircraft	10.07	10.37	0.89	0.65	3.40	3.40
Vessel	0.00	0.00	0.00	0.00	0.00	0.00
Ordnance	0.83	0.01	0.00	0.00	0.02	0.01
Total	**10.90**	**10.38**	**0.89**	**0.65**	**3.41**	**3.41**
Total for Key West Range Complex						
Aircraft	10.07	10.37	0.89	0.65	3.40	3.40
Vessel	0.01	0.34	0.00	0.04	0.00	0.00
Ordnance	0.92	0.01	0.00	0.00	0.02	0.01
Total	**11.00**	**10.72**	**0.89**	**0.68**	**3.42**	**3.41**
				Percent In-State		0.01
Gulf of Mexico Range Complex						
State waters (0-9 nm)						
Aircraft	4.34	4.45	0.38	0.28	1.46	1.46
Vessel	0.09	3.32	0.14	0.36	0.02	0.02
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**4.43**	**7.77**	**0.53**	**0.63**	**1.48**	**1.48**

Tab B Table 1. Estimated Annual Criteria Air Pollutant Emissions from Training, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Waters of the U.S. (9-12 nm)						
Aircraft	0.04	0.05	0.00	0.00	0.01	0.01
Vessel	2.41	1.70	0.59	0.56	0.05	0.05
Ordnance	0.16	0.00	0.00	0.00	0.01	0.01
Total	**2.62**	**1.74**	**0.59**	**0.57**	**0.08**	**0.08**
International waters (>12 nm)						
Aircraft	3.57	6.98	0.34	0.32	1.91	1.91
Vessel	69.18	40.81	6.23	18.34	1.58	1.58
Ordnance	1.48	0.03	0.00	0.00	0.10	0.06
Total	**74.23**	**47.82**	**6.57**	**18.66**	**3.59**	**3.55**
Total for GOMEX Range Complex						
Aircraft	7.95	11.47	0.73	0.60	3.38	3.38
Vessel	71.68	45.83	6.96	19.26	1.65	1.65
Ordnance	1.64	0.03	0.00	0.00	0.11	0.07
Total	**81.27**	**57.33**	**7.69**	**19.85**	**5.15**	**5.11**
				Percent In-State		0.09
Other AFTT Areas (Outside Range Complexes)						
State waters (0-3 nm)						
Aircraft	0.00	0.00	0.00	0.00	0.00	0.00
Vessel	0.13	0.11	0.13	0.03	0.00	0.00
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.13**	**0.11**	**0.13**	**0.03**	**0.00**	**0.00**
Waters of the U.S. (3-12 nm)						
Aircraft	0.06	0.07	0.01	0.00	0.02	0.02
Vessel	6.44	4.61	0.95	1.41	0.13	0.13
Ordnance	0.09	0.01	0.00	0.00	0.00	0.00
Total	**6.59**	**4.69**	**0.96**	**1.41**	**0.16**	**0.16**
International waters (>12 nm)						
Aircraft	0.42	0.45	0.05	0.02	0.13	0.13
Vessel	26.01	19.79	2.37	7.75	0.73	0.73
Ordnance	0.78	0.07	0.00	0.00	0.02	0.01
Total	**27.22**	**20.32**	**2.42**	**7.77**	**0.87**	**0.87**
Total for Other AFTT Areas (Outside Range Complexes)						
Aircraft	0.49	0.52	0.06	0.03	0.15	0.15
Vessel	32.57	24.51	3.45	9.18	0.86	0.86
Ordnance	0.87	0.08	0.00	0.00	0.02	0.02
Total	**33.93**	**25.12**	**3.51**	**9.21**	**1.03**	**1.03**
				Percent In-State		0.01

Tab B Table 1. Estimated Annual Criteria Air Pollutant Emissions from Training, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Total for AFTT Study Area (Training-Related Emissions)						
State waters (0-3 nm)						
Aircraft	39.62	41.70	3.55	2.58	13.47	13.47
Vessel	23.08	79.06	9.77	45.68	3.89	3.89
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**62.70**	**120.76**	**13.32**	**48.26**	**17.35**	**17.35**
Waters of the U.S. (3-12 nm)						
Aircraft	4.94	5.58	0.45	0.34	1.78	1.78
Vessel	249.06	185.02	40.51	86.84	7.71	7.71
Ordnance	4.42	0.17	0.00	0.00	0.29	0.18
Total	**258.42**	**190.77**	**40.96**	**87.18**	**9.78**	**9.67**
International waters (>12 nm)						
Aircraft	88.90	475.16	11.06	15.72	111.81	111.81
Vessel	2,311.32	1,369.57	203.38	583.89	49.24	49.24
Ordnance	39.79	1.56	0.00	0.00	2.65	1.62
Total	**2440.01**	**1846.29**	**214.44**	**599.61**	**163.70**	**162.68**
Total for Study Area Complexes						
Aircraft	133.47	522.44	15.06	18.64	127.06	127.06
Vessel	2583.45	1633.66	253.66	716.40	60.83	60.83
Ordnance	44.21	1.73	0.00	0.00	2.94	1.80
Total	**2761.13**	**2157.83**	**268.72**	**735.04**	**190.84**	**189.70**

Tab B Table 2. Estimated Annual Criteria Air Pollutant Emissions from Testing, Alternative 2

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NOx***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Northeast Range Complex						
State waters (0-3 nm)						
Aircraft	0.01	0.03	0.00	0.00	0.01	0.01
Vessel	0.98	3.60	0.08	0.39	0.06	0.06
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.99**	**3.62**	**0.08**	**0.39**	**0.08**	**0.07**
Waters of the U.S. (3-12 nm)						
Aircraft	0.26	0.28	0.02	0.02	0.09	0.09
Vessel	3.34	3.25	0.30	0.78	0.08	0.08
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3.61**	**3.52**	**0.32**	**0.80**	**0.17**	**0.17**
International waters (>12 nm)						
Aircraft	1.27	1.76	0.14	0.11	0.54	0.54
Vessel	62.53	40.17	5.75	19.02	1.70	1.70
Ordnance	0.02	0.00	0.00	0.00	0.01	0.00
Total	**63.83**	**41.93**	**5.89**	**19.12**	**2.25**	**2.25**
Total for Northeast Range Complex						
Aircraft	1.54	2.06	0.16	0.12	0.64	0.64
Vessel	66.86	47.02	6.12	20.19	1.85	1.85
Ordnance	0.02	0.00	0.00	0.00	0.01	0.00
Total	**68.42**	**49.08**	**6.29**	**20.31**	**2.50**	**2.49**
Virginia Capes Range Complex						
State waters (0-3 nm)						
Aircraft	1.29	1.34	0.11	0.08	0.44	0.44
Vessel	1.91	3.02	0.16	0.48	0.06	0.06
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3.20**	**4.36**	**0.27**	**0.57**	**0.50**	**0.50**
Waters of the U.S. (3-12 nm)						
Aircraft	1.80	1.86	0.16	0.12	0.61	0.61
Vessel	18.91	13.84	1.75	4.08	0.39	0.39
Ordnance	0.41	0.02	0.00	0.00	0.06	0.04
Total	**21.11**	**15.72**	**1.91**	**4.19**	**1.06**	**1.04**
International waters (>12 nm)						
Aircraft	12.15	17.10	1.15	0.88	4.96	4.96
Vessel	289.14	171.98	25.43	67.95	5.71	5.71
Ordnance	3.65	0.17	0.00	0.00	0.52	0.35
Total	**304.94**	**189.24**	**26.58**	**68.83**	**11.19**	**11.01**
Total for Virginia Capes Range Complex						
Aircraft	15.23	20.30	1.42	1.07	6.01	6.01
Vessel	309.96	188.84	27.34	72.51	6.16	6.16
Ordnance	4.06	0.19	0.00	0.00	0.58	0.39
Total	**329.25**	**209.32**	**28.76**	**73.59**	**12.74**	**12.55**
				Percent In-State		0.01

Tab B Table 2. Estimated Annual Criteria Air Pollutant Emissions from Testing, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NOx***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Cherry Point Range Complex						
State waters (0-3 nm)						
Aircraft	0.00	0.01	0.00	0.00	0.00	0.00
Vessel	0.52	2.20	0.04	0.23	0.04	0.04
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.53**	**2.22**	**0.04**	**0.23**	**0.04**	**0.04**
Waters of the U.S. (3-12 nm)						
Aircraft	0.09	0.09	0.01	0.01	0.03	0.03
Vessel	0.73	1.30	0.08	0.26	0.03	0.03
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.82**	**1.40**	**0.09**	**0.26**	**0.06**	**0.06**
International waters (>12 nm)						
Aircraft	3.99	4.33	0.36	0.27	1.39	1.39
Vessel	32.86	22.86	3.25	12.87	1.22	1.22
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**36.86**	**27.19**	**3.61**	**13.13**	**2.61**	**2.61**
Total for Cherry Point Range Complex						
Aircraft	4.08	4.43	0.37	0.27	1.42	1.42
Vessel	34.12	26.36	3.37	13.35	1.29	1.29
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**38.20**	**30.80**	**3.74**	**13.62**	**2.72**	**2.71**
				Percent In-State		0.03
Jacksonville Range Complex						
State waters (0-3 nm)						
Aircraft	0.01	0.03	0.00	0.00	0.01	0.01
Vessel	0.72	2.32	0.06	0.26	0.04	0.04
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.72**	**2.35**	**0.06**	**0.27**	**0.05**	**0.05**
Waters of the U.S. (3-12 nm)						
Aircraft	0.43	0.45	0.04	0.03	0.15	0.15
Vessel	10.27	9.28	1.06	1.97	0.23	0.23
Ordnance	0.17	0.00	0.00	0.00	0.02	0.01
Total	**10.86**	**9.73**	**1.10**	**2.00**	**0.39**	**0.39**
International waters (>12 nm)						
Aircraft	5.77	6.90	0.54	0.40	2.14	2.14
Vessel	93.10	74.89	9.56	28.51	2.90	2.90
Ordnance	1.52	0.04	0.00	0.00	0.16	0.12
Total	**100.39**	**81.83**	**10.09**	**28.91**	**5.21**	**5.16**
Total for Jacksonville Range Complex						
Aircraft	6.21	7.37	0.58	0.43	2.30	2.30
Vessel	104.09	86.49	10.67	30.75	3.17	3.17
Ordnance	1.69	0.05	0.00	0.00	0.18	0.13
Total	**111.98**	**93.91**	**11.25**	**31.18**	**5.65**	**5.59**

Tab B Table 2. Estimated Annual Criteria Air Pollutant Emissions from Testing, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NOx***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Percent In-State						0.01
Key West Range Complex						
State waters (0-3 nm)						
Aircraft	0.00	0.00	0.00	0.00	0.00	0.00
Vessel	0.05	0.07	0.00	0.01	0.00	0.00
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.05**	**0.07**	**0.00**	**0.01**	**0.00**	**0.00**
Waters of the U.S. (3-12 nm)						
Aircraft	0.10	0.11	0.01	0.01	0.03	0.03
Vessel	1.11	0.89	0.11	0.29	0.03	0.03
Ordnance	0.01	0.00	0.00	0.00	0.00	0.00
Total	**1.23**	**1.00**	**0.12**	**0.30**	**0.06**	**0.06**
International waters (>12 nm)						
Aircraft	0.42	0.48	0.04	0.03	0.15	0.15
Vessel	7.85	5.89	0.74	1.91	0.18	0.18
Ordnance	0.11	0.03	0.00	0.00	0.00	0.00
Total	**8.38**	**6.40**	**0.78**	**1.94**	**0.34**	**0.34**
Total for Key West Range Complex						
Aircraft	0.52	0.59	0.05	0.04	0.19	0.19
Vessel	9.02	6.85	0.86	2.22	0.21	0.21
Ordnance	0.12	0.03	0.00	0.00	0.00	0.00
Total	**9.66**	**7.47**	**0.90**	**2.25**	**0.41**	**0.40**
				Percent In-State		0.01
Gulf of Mexico Range Complex						
State waters (0-9 nm)						
Aircraft	3.86	3.96	0.34	0.25	1.30	1.30
Vessel	1.32	2.76	0.11	0.38	0.05	0.05
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**5.18**	**6.72**	**0.45**	**0.63**	**1.35**	**1.35**
Waters of the U.S. (9-12 nm)						
Aircraft	1.43	1.47	0.13	0.09	0.48	0.48
Vessel	4.11	4.23	0.46	2.51	0.25	0.25
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**5.54**	**5.70**	**0.58**	**2.60**	**0.73**	**0.73**
International waters (>12 nm)						
Aircraft	1.12	1.43	0.11	0.09	0.45	0.45
Vessel	23.88	20.61	2.62	14.08	1.36	1.36
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**25.00**	**22.05**	**2.73**	**14.16**	**1.81**	**1.81**
Total for GOMEX Range Complex						

Tab B Table 2. Estimated Annual Criteria Air Pollutant Emissions from Testing, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	***CO***	***NOx***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***
Aircraft	6.42	6.87	0.58	0.43	2.23	2.23
Vessel	29.30	27.60	3.18	16.96	1.67	1.67
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**35.72**	**34.47**	**3.76**	**17.39**	**3.89**	**3.89**
				Percent In-State		0.16
Other AFTT Areas (Outside Range Complexes)						
State waters (0-3 nm)						
Aircraft	0.01	0.02	0.00	0.00	0.01	0.01
Vessel	0.04	0.04	0.00	0.01	0.00	0.00
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.04**	**0.06**	**0.00**	**0.01**	**0.01**	**0.01**
Waters of the U.S. (3-12 nm)						
Aircraft	0.00	0.01	0.00	0.00	0.00	0.00
Vessel	0.65	0.65	0.07	0.20	0.02	0.02
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.65**	**0.66**	**0.07**	**0.20**	**0.03**	**0.03**
International waters (>12 nm)						
Aircraft	0.10	0.49	0.02	0.02	0.11	0.11
Vessel	4.84	4.37	0.51	1.35	0.15	0.15
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**4.95**	**4.85**	**0.54**	**1.37**	**0.26**	**0.26**
Total for Other AFTT Areas (Outside Range Complexes)						
Aircraft	0.11	0.52	0.03	0.02	0.12	0.12
Vessel	5.53	5.05	0.59	1.56	0.17	0.17
Ordnance	0.00	0.00	0.00	0.00	0.01	0.00
Total	**5.64**	**5.57**	**0.61**	**1.58**	**0.30**	**0.29**
				Percent In-State		0.01
Total for AFTT Study Area (Testing-Related Emissions)						
State waters (0-3 nm)						
Aircraft	5.16	5.40	0.46	0.34	1.76	1.76
Vessel	5.55	14.00	0.45	1.77	0.26	0.26
Ordnance	0.00	0.00	0.00	0.00	0.00	0.00
Total	**10.71**	**19.40**	**0.91**	**2.10**	**2.02**	**2.01**
Waters of the U.S. (3-12 nm)						
Aircraft	4.11	4.28	0.37	0.27	1.40	1.40
Vessel	39.12	33.43	3.83	10.08	1.03	1.03
Ordnance	0.59	0.03	0.00	0.00	0.08	0.05
Total	**43.82**	**37.74**	**4.19**	**10.35**	**2.51**	**2.48**
International waters (>12 nm)						
Aircraft	24.84	32.48	2.36	1.79	9.75	9.75
Vessel	514.21	340.77	47.86	145.69	13.22	13.22
Ordnance	5.30	0.24	0.00	0.00	0.70	0.47
Total	**544.34**	**373.49**	**50.22**	**147.48**	**23.67**	**23.44**

Tab B Table 2. Estimated Annual Criteria Air Pollutant Emissions from Testing, Alternative 2 (continued)

	Emissions by Criteria Air Pollutant (TPY)					
Source	*CO*	*NOx*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*
Total for Study Area Complexes						
Aircraft	**34.11**	**42.15**	**3.18**	**2.39**	**12.91**	**12.90**
Vessel	**558.87**	**388.21**	**52.14**	**157.54**	**14.51**	**14.51**
Ordnance	**5.89**	**0.26**	**0.00**	**0.00**	**0.78**	**0.52**
Total	**598.88**	**430.62**	**55.32**	**159.93**	**28.20**	**27.93**

Tab C: Emissions Summary

Tab C Table 1. Vessel Emissions by OPAREA - outside of state waters

	Annual Totals in Tons per Year for Alternative 1					*Metric Tons*	*Annual Totals in Tons per Year for Alternative 2*					*Metric Tons*
	VOCs	*CO*	*NO_x*	*SO_x*	*PM*	*CO^2e*	*VOCs*	*CO*	*NO_x*	*SO_x*	*PM*	*CO^2e*
Northeast	1.2	6.4	31.9	10.4	1.5	5,562	0.1	2.2	4.2	0.6	0.2	306
VACAPES	108.2	755.4	3405.0	932.5	107.6	502,660	101.8	727.4	3,649.0	1,011.1	118.4	520,997
Cherry Pt	34.7	284.4	802.7	155.7	25.0	71,511	24.0	121.6	705.7	177.9	27.2	82,995
JAX	33.1	348.9	972.3	291.3	26.8	156,452	44.4	460.5	1,887.4	522.9	54.1	273,108
Key West	2.6	8.3	75.1	12.3	1.6	6,215	0.6	8.2	26.5	9.4	0.8	4,906
GOMEX	7.3	106.7	404.1	104.7	14.4	54,137	0.7	11.9	47.7	15.8	1.8	9,430
Outside RCs	52.8	322.5	1672.1	380.0	49.1	215,403	158.8	530.0	4,084.2	641.6	80.4	325,203

Tab C Table 2. Vessel Emissions by OPAREA - inside of state waters

	Annual Totals in Tons per Year for Alternative 1					*Metric Tons*	*Annual Totals in Tons per Year for Alternative 2*					*Metric Tons*
	VOCs	*CO*	*NO_x*	*SOx*	*PM*	*CO^2e*	*VOCs*	*CO*	*NOx*	*SO_x*	*PM*	*CO^2e*
Northeast	0.0	0.1	0.9	0.2	0.0	99	0.0	0.1	0.4	0.0	0.0	15
VACAPES	2.3	12.8	71.2	18.9	2.2	11,587	2.5	15.2	75.4	19.4	2.4	11,619
Cherry Pt	0.1	0.3	2.2	0.5	0.1	237	0.1	0.2	1.7	0.3	0.0	163
JAX	0.3	2.6	11.1	3.0	0.4	1,889	0.5	5.6	17.2	4.2	0.7	2,559
Key West	0.0	0.1	0.7	0.2	0.0	107	0.0	0.1	0.6	0.1	0.0	79
GOMEX	0.1	0.4	1.4	0.2	0.1	112	0.0	0.1	0.7	0.1	0.0	58
Outside RCs	0.1	0.4	2.4	0.5	0.1	273	2.6	28.4	66.3	11.7	2.6	6,865

Tab C Table 3. Small Boat and Riverine Vessels by OPAREA, Alternative 1 & Alternative 2

	Annual Totals in Tons per Year					*Metric Tons*
	VOCs	*CO*	*NO_x*	*SO_x*	*PM*	*CO^2e*
Northeast	4.1	10.1	98.4	14.7	2.4	5,552
VACAPES	3.6	33.8	87.4	9.8	3.0	6,363
Chesapeake Bay	37.1	139.5	746.9	104.3	20.9	47,922
Charleston	3.5	8.8	85.6	12.8	2.1	4,673
JAX	0.9	3.4	12.9	1.7	0.5	1,103
Cape Canaveral/ SE FL	3.8	9.5	92.7	13.8	2.2	5,359
Key West	0.0	0.0	0.0	0.0	0.0	0
Panama City	0.3	1.0	3.5	0.5	0.1	249
GOMEX	0.0	0.0	0.0	0.0	0.0	0

Tab C Table 4. Aircraft Emissions by OPAREA

	Annual Totals in Tons per Year for Alternative 1					*Metric Tons*	*Annual Totals in Tons per Year for Alternative 2*					*Metric Tons*
Area	*VOCs*	*CO*	*NO_x*	*SO_x*	*PM*	*CO^2e*	*VOCs*	*CO*	*NO_x*	*SO_x*	*PM*	*CO^2e*
Northeast	0.8	7.7	12.1	3.0	4.7	4,339	1.3	13.2	17.8	5.0	8.4	7,184
VACAPES	7.8	88.6	159.0	22.8	39.5	47,176	10.0	110.2	181.2	30.5	54.0	58,316
Cherry Pt	5.5	39.3	28.2	3.7	4.9	7,693	5.5	39.3	28.2	3.7	4.9	7,693
JAX	15.1	96.0	73.6	10.5	12.8	18,961	15.4	98.5	76.1	11.4	14.5	20,236
Key West	0.1	0.9	1.0	0.3	0.6	496	0.3	3.1	3.2	1.1	2.1	1,603
GOMEX	1.0	11.8	11.0	3.7	6.6	5,408	1.0	12.0	11.2	3.8	6.8	5,501
Panama City	0.9	8.4	8.6	3.0	5.7	4,352	1.0	10.0	10.2	3.5	6.7	5,148

Tab C Table 5. Aircraft Emissions within state waters boundaries by OPAREA

	Annual Totals in Tons per Year for Alternative 1					*Metric Tons*	*Annual Totals in Tons per Year for Alternative 2*					*Metric Tons*
Area	***VOCs***	***CO***	***NO_x***	***SO_x***	***PM***	***CO^2e***	***VOCs***	***CO***	***NO_x***	***SO_x***	***PM***	***CO^2e***
Northeast	0	0	0	0	0	0	0	0	0	0	0	0
VACAPES	1.0	11.1	28.0	3.3	6.4	7,797	1.0	11.1	28.0	3.3	6.4	7,797
Cherry Pt	11.8	193.6	101.9	40.8	77.1	59,064	11.8	193.6	101.9	40.8	77.1	59,064
JAX	0.1	0.6	0.6	0.2	0.4	307	0.1	0.6	0.6	0.2	0.4	307
Key West	0.0	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0
GOMEX	0.0	0.1	0.1	0.0	0.1	39	0.0	0.1	0.1	0.0	0.1	39
Panama City	0.9	8.4	8.6	3.0	5.7	4,352	1.0	10.0	10.2	3.5	6.7	5,148

Tab C Table 6. Munition Emissions by OPAREA

	Alternative 1								Alternative 2							
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO^2e	Pb	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO^2e	Pb
Location	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Mton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Ton/yr	Mton/yr	Ton/yr
Northeast / NUWC Newport	0.0	0.7	0.0	0.0	1.1	0.8	1.51	0.0	0.0	0.7	0.0	0.0	1.1	0.8	1.50	0.0
Virginia Capes	0.0	49.2	0.9	0.0	33.7	25.8	38.42	0.2	0.0	49.2	0.9	0.0	33.7	25.8	38.42	0.2
Cherry Pt.	0.0	16.0	0.3	0.0	5.8	4.3	10.35	0.0	0.0	16.0	0.3	0.0	5.8	4.3	10.35	0.0
Jacksonville	0.0	34.8	0.6	0.0	19.1	14.3	31.03	0.2	0.0	34.8	0.6	0.0	19.1	14.3	31.03	0.2
Key West	0.0	2.9	0.1	0.0	0.8	0.5	3.02	0.0	0.0	2.9	0.1	0.0	0.8	0.5	3.02	0.0
GOMEX / Panama City	0.0	3.4	0.1	0.0	1.2	0.8	4.09	0.0	0.0	3.4	0.1	0.0	1.2	0.8	4.09	0.0
Other AFTT	0.0	1.4	0.0	0.0	0.4	0.3	0.65	0.0	0.0	1.4	0.0	0.0	0.4	0.3	0.65	0.0
Study Area Total	**0.04**	**108.39**	**1.95**	**0.01**	**62.08**	**46.77**	**89.07**	**0.44**	**0.04**	**108.39**	**1.95**	**0.01**	**62.07**	**46.76**	**89.07**	**0.44**

Tab C Table 7. Emissions within State Water Boundaries

	All Emissions in State Waters, Alternative 1 in tons/yr					All Emissions in State Waters, Alternative 2 in tons/yr				
Area	VOCs	CO	NO_x	SO_x	PM	VOCs	CO	NO_x	SO_x	PM
Northeast	4.1	10.2	99.4	14.9	3.4	4.1	10.2	98.8	14.7	3.4
VACAPES	6.9	57.7	186.6	32.1	11.6	7.2	60.1	190.8	32.5	11.8
Chesapeake Bay	37.8	139.5	746.9	104.3	36.8	37.8	139.5	746.9	104.3	36.8
Cherry Pt	0.1	0.3	2.2	0.5	0.1	11.9	193.8	103.6	41.1	77.2
Charleston	3.5	8.8	85.6	12.8	2.1	3.5	8.8	85.6	12.8	2.1
JAX	1.3	6.6	24.6	4.9	1.3	1.5	9.6	30.7	6.1	1.6
Cape Canaveral/ SE FL	3.8	9.5	92.7	13.8	3.2	3.8	9.5	92.7	13.8	3.2
Key West	0.0	0.1	0.7	0.2	0.0	0.0	0.1	0.6	0.1	0.0
Panama City	1.1	9.5	12.2	3.5	5.8	1.3	11.0	13.8	4.0	6.9
GOMEX	0.1	0.5	1.5	0.3	0.1	0.0	0.2	0.8	0.1	0.1
Outside RCs	0.1	0.4	2.4	0.5	0.1	2.6	28.4	66.3	11.7	2.6

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Tab D: Ship Emissions

Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA

		Alternative 1		*Alternative 2*		*Alternative 1*						*Alternative 1*					
		Steaming Hrs[1]	*Steaming Hrs[1]*	*Steaming Hrs[1]*	*Steaming Hrs[1]*	*Annual Emissions in Tons*						*Restricted Waters Only Annual Emissions in Tons*					
		Open Water	*State Waters*	*Open Water*	*State Waters*	*CO*	*NOx*	*HC*	*SO_x*	*PM_{10}*	*CO^2*	*CO*	*NO_x*	*HC*	*SO_x*	*PM_{10}*	*CO^2*
CVN	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	2,761	57	1,728	35	1.70	23.14	0.43	1.92	0.17	946	0.00	0.05	0.00	0.00	0.00	2
	Cherry Pt	46	1	0	0	0.03	0.39	0.01	0.03	0.00	16	0.00	0.00	0.00	0.00	0.00	0
	JAX	1,207	13	1,032	10	0.74	10.11	0.19	0.84	0.07	413	0.00	0.01	0.00	0.00	0.00	0
	Key West	86	1	96	1	0.05	0.72	0.01	0.06	0.01	29	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	551	1	792	1	0.34	4.61	0.09	0.38	0.03	188	0.00	0.00	0.00	0.00	0.00	0
CG	Northeast	91	1	0	0	2.81	3.76	0.20	2.53	0.11	1,136	0.01	0.14	0.00	0.05	0.01	35
	VACAPES	6,699	137	4,032	81	207.93	286.11	14.64	190.08	8.22	85,811	1.90	19.56	0.17	7.53	0.69	4,784
	Cherry Pt	1,122	2	552	1	34.53	44.93	2.43	30.68	1.27	13,641	0.03	0.29	0.00	0.11	0.01	70
	JAX	2,756	28	3,384	34	85.15	113.66	5.99	76.64	3.24	34,313	0.39	4.00	0.03	1.54	0.14	978
	Key West	47	1	120	1	1.46	2.01	0.10	1.34	0.06	603	0.01	0.14	0.00	0.05	0.01	35
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	551	1	1,704	2	16.96	22.07	1.19	15.07	0.62	6,699	0.01	0.14	0.00	0.05	0.01	35
DDG -1000	Northeast	110	1	0	0	1.86	8.76	0.11	3.30	0.32	2,051	0.02	0.03	0.00	0.01	0.00	12
	VACAPES	15,326	313	16,272	325	263.47	1226.03	15.01	462.62	44.70	287,865	7.14	10.14	0.45	4.68	0.63	3,764
	Cherry Pt	47	1	1,368	1	0.81	3.76	0.05	1.42	0.14	883	0.02	0.03	0.00	0.01	0.00	12
	JAX	4,875	50	5,400	54	82.68	388.38	4.70	146.41	14.12	90,970	1.14	1.62	0.07	0.75	0.10	601
	Key West	86	1	96	1	1.46	6.86	0.08	2.58	0.25	1,606	0.02	0.03	0.00	0.01	0.00	12
	GOMEX	148	1	408	1	2.50	11.77	0.14	4.44	0.43	2,756	0.02	0.03	0.00	0.01	0.00	12
	Outside RCs	7,466	8	2,976	264	125.05	592.57	7.10	223.20	21.48	138,495	0.18	0.26	0.01	0.12	0.02	96
LCS	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0
	VACAPES	0	0	3,240	65	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0
	Cherry Pt	0	0	696	1	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0
	JAX	756	14	9,000	90	17.99	71.67	1.25	18.92	2.57	9,723	0.55	1.06	0.04	0.16	0.05	77
	Key West	24	1	120	1	0.59	2.32	0.04	0.61	0.08	312	0.04	0.08	0.00	0.01	0.00	6
	GOMEX	3,858	7	120	1	89.28	360.81	6.17	95.82	12.89	49,253	0.28	0.53	0.02	0.08	0.03	39
	Outside RCs	314	1	8,592	536	7.28	29.41	0.50	7.81	1.05	4,014	0.02	0.04	0.00	0.01	0.00	3
LSD	Northeast	57	1	0	0	0.63	9.84	0.32	0.72	0.06	474	0.02	0.30	0.01	0.02	0.00	11
	VACAPES	2,756	57	2,400	48	30.42	478.18	15.52	35.19	3.05	23,014	1.14	17.22	0.58	1.29	0.06	602
	Cherry Pt	1,093	2	840	1	11.65	183.41	5.94	13.49	1.19	8,909	0.04	0.60	0.02	0.05	0.00	21
	JAX	14	1	0	0	0.17	2.64	0.09	0.19	0.02	124	0.02	0.30	0.01	0.02	0.00	11
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	19	1	0	0	0.22	3.48	0.11	0.26	0.02	165	0.02	0.30	0.01	0.02	0.00	11
	Outside RCs	1,088	2	1,128	50	11.60	182.58	5.92	13.43	1.18	8,869	0.04	0.60	0.02	0.05	0.00	21
LHA	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0	0	16	1	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Cherry Pt	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0	0	2	1	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	62	1	22	1	0.26	8.75	0.46	2.11	0.26	1,132	0.00	0.14	0.01	0.03	0.00	18

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Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 1		Alternative 2		Alternative 1						Alternative 1					
		Steaming Hrs[1]	Steaming Hrs[1]	Steaming Hrs[1]	Steaming Hrs[1]	Annual Emissions in Tons						Restricted Waters Only Annual Emissions in Tons					
		Open Water	State Waters	Open Water	State Waters	CO	NOx	HC	SO_x	PM_{10}	CO^2	CO	NO_x	HC	SO_x	PM_{10}	CO^2
LHD	Northeast	57	1	0	0	0.23	1.38	0.17	2.77	0.83	1,381	0.00	0.02	0.00	0.06	0.01	24
	VACAPES	1,957	40	2,328	47	8.06	47.60	5.75	95.49	28.44	47,558	0.15	0.80	0.10	2.41	0.48	950
	Cherry Pt	1,155	2	1,056	1	4.67	27.66	3.34	55.05	16.52	27,555	0.01	0.04	0.01	0.12	0.02	47
	JAX	28	1	0	0	0.12	0.69	0.08	1.39	0.41	691	0.00	0.02	0.00	0.06	0.01	24
	Key West	47	1	0	0	0.19	1.14	0.14	2.30	0.68	1,143	0.00	0.02	0.00	0.06	0.01	24
	GOMEX	14	1	0	0	0.06	0.35	0.04	0.73	0.21	357	0.00	0.02	0.00	0.06	0.01	24
	Outside RCs	892	1	960	1	3.61	21.35	2.58	42.48	12.75	21,268	0.00	0.02	0.00	0.06	0.01	24
LPD	Northeast	67	1	0	0	1.07	9.25	0.57	1.27	0.11	569	0.01	0.13	0.01	0.02	0.00	8
	VACAPES	1,839	38	3,216	64	29.60	255.37	15.79	35.14	3.08	15,703	0.53	5.01	0.28	0.63	0.05	285
	Cherry Pt	758	1	888	1	11.99	103.33	6.40	14.24	1.25	6,362	0.01	0.13	0.01	0.02	0.00	8
	JAX	157	2	48	1	2.51	21.64	1.34	2.98	0.26	1,331	0.03	0.26	0.01	0.03	0.00	15
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	86	1	168	1	1.37	11.84	0.73	1.63	0.14	729	0.01	0.13	0.01	0.02	0.00	8
	Outside RCs	1,160	2	1,800	3	18.36	158.19	9.79	21.81	1.91	9,740	0.03	0.26	0.01	0.03	0.00	15
PC	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	122	3	8	2	20.64	4.64	0.38	1.03	0.14	480	0.06	0.12	0.01	0.03	0.00	12
	Cherry Pt	1,088	2	5	1	183.57	40.43	3.28	8.96	1.22	4,184	0.04	0.08	0.01	0.02	0.00	8
	JAX	622	7	44	5	105.07	23.34	1.90	5.17	0.70	2,416	0.15	0.27	0.03	0.06	0.01	28
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	33	1	2	1	5.59	1.26	0.10	0.28	0.04	131	0.02	0.04	0.00	0.01	0.00	4
	Outside RCs	311	1	22	1	52.48	11.57	0.94	2.56	0.35	1,198	0.02	0.04	0.00	0.01	0.00	4
JHSV	Northeast	0	0	11	1	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	621	13	23	6	119.97	232.82	5.35	35.45	11.31	16,951	0.66	1.30	0.03	0.20	0.06	94
	Cherry Pt	9	1	1	1	1.78	3.46	0.08	0.53	0.17	252	0.05	0.10	0.00	0.02	0.00	7
	JAX	123	2	8	1	23.73	46.06	1.06	7.01	2.24	3,353	0.10	0.20	0.00	0.03	0.01	15
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	43	1	9	1	8.31	16.13	0.37	2.46	0.78	1,174	0.05	0.10	0.00	0.02	0.00	7
	Outside RCs	311	1	45	1	59.80	116.05	2.67	17.67	5.64	8,449	0.05	0.10	0.00	0.02	0.00	7
MV	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	231	5	0	0	0.80	15.66	0.44	1.43	0.26	631	0.01	0.22	0.01	0.09	0.03	46
	Cherry Pt	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	1,026	2	2,256	2	3.50	68.70	1.92	5.99	1.06	2,621	0.00	0.09	0.00	0.04	0.01	18
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	451	1	312	1	1.54	30.20	0.84	2.63	0.47	1,153	0.00	0.04	0.00	0.02	0.01	9
SSGN	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Cherry Pt	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	204	3	1,920	19	0.01	0.41	0.01	0.02	0.00	14	0.00	0.00	0.00	0.00	0.00	0
	Key West	566	1	888	1	0.03	1.15	0.02	0.07	0.01	37	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	148	1	240	1	0.01	0.30	0.01	0.02	0.00	10	0.00	0.00	0.00	0.00	0.00	0

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Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 1		*Alternative 2*		*Alternative 1*						*Alternative 1*					
		Steaming Hrs[1]	*Steaming Hrs[1]*	*Steaming Hrs[1]*	*Steaming Hrs[1]*	*Annual Emissions in Tons*						*Restricted Waters Only Annual Emissions in Tons*					
		Open Water	*State Waters*	*Open Water*	*State Waters*	*CO*	*NOx*	*HC*	*SO_x*	*PM_{10}*	*CO^2*	*CO*	*NO_x*	*HC*	*SO_x*	*PM_{10}*	*CO^2*
	Northeast	10,050	11	0	0	0.60	4.57	0.25	0.85	0.15	409	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	3,871	80	6,888	138	0.23	1.76	0.10	0.33	0.06	158	0.00	0.00	0.00	0.00	0.00	0
	Cherry Pt	354	1	0	0	0.02	0.16	0.01	0.03	0.01	14	0.00	0.00	0.00	0.00	0.00	0
SSN	JAX	1,397	15	1,920	19	0.08	0.64	0.03	0.12	0.02	57	0.00	0.00	0.00	0.00	0.00	0
	Key West	129	1	0	0	0.01	0.06	0.00	0.01	0.00	5	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	23	1	0	0	0.00	0.01	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	11,458	12	20,424	7340	0.69	5.21	0.29	0.97	0.17	467	0.00	0.00	0.00	0.00	0.00	0
	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	38	1	72	1	0.27	2.02	0.13	1.41	0.40	698	0.01	0.05	0.00	0.04	0.01	18
	Cherry Pt	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
T-AH	JAX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	4	1	24	0	0.03	0.26	0.02	0.18	0.05	89	0.01	0.05	0.00	0.04	0.01	18
	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	1,505	31	600	12	7.82	228.84	22.56	27.83	3.53	13,053	0.08	1.34	0.19	0.17	0.02	83
	Cherry Pt	331	1	144	1	1.70	50.08	4.93	6.09	0.77	2,855	0.00	0.04	0.01	0.01	0.00	3
T-AKE	JAX	395	4	192	2	2.04	59.88	5.90	7.28	0.92	3,415	0.01	0.17	0.02	0.02	0.00	11
	Key West	19	1	0	0	0.10	2.92	0.29	0.35	0.04	166	0.00	0.04	0.01	0.01	0.00	3
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	892	1	3,888	4	4.59	134.88	13.27	16.40	2.08	7,690	0.00	0.04	0.01	0.01	0.00	3
	Northeast	9	1	0	0	0.25	3.48	0.11	0.23	0.02	102	0.02	0.27	0.01	0.02	0.00	8
	VACAPES	2,018	42	2,328	47	52.73	730.84	23.85	48.44	4.29	21,393	0.75	11.31	0.38	0.82	0.07	325
	Cherry Pt	1,098	2	624	1	28.31	392.04	12.79	25.95	2.30	11,479	0.04	0.54	0.02	0.04	0.00	15
T-AO	JAX	955	10	1,056	11	24.78	343.20	11.20	22.73	2.01	10,048	0.18	2.69	0.09	0.20	0.02	77
	Key West	139	1	0	0	3.60	49.83	1.63	3.30	0.29	1,459	0.02	0.27	0.01	0.02	0.00	8
	GOMEX	28	1	0	0	0.74	10.25	0.33	0.68	0.06	300	0.02	0.27	0.01	0.02	0.00	8
	Outside RCs	1,477	2	5,688	6	38.08	527.17	17.20	34.89	3.09	15,436	0.04	0.54	0.02	0.04	0.00	15
	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	658	14	2,328	47	36.36	105.54	3.53	28.65	2.82	2,789	0.25	3.12	0.04	0.94	0.09	570
	Cherry Pt	283	1	624	1	15.55	44.27	1.50	11.99	1.18	995	0.02	0.22	0.00	0.07	0.01	41
T-AOE	JAX	76	1	264	3	4.19	12.05	0.41	3.27	0.32	297	0.02	0.22	0.00	0.07	0.01	41
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Northeast	4	1	0	0	0.01	0.08	0.00	0.02	0.00	9	0.00	0.02	0.00	0.00	0.00	2
	VACAPES	555	12	720	14	0.91	9.17	0.36	1.93	0.25	970	0.02	0.23	0.00	0.05	0.00	24
	Cherry Pt	268	1	0	0	0.43	4.34	0.17	0.91	0.12	459	0.00	0.02	0.00	0.00	0.00	2
T-ARS	JAX	142	2	96	1	0.23	2.33	0.09	0.49	0.06	246	0.00	0.04	0.00	0.01	0.00	4
	Key West	499	1	0	0	0.80	8.06	0.32	1.69	0.22	853	0.00	0.02	0.00	0.00	0.00	2
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	758	1	2,784	3	1.21	12.23	0.48	2.57	0.34	1,295	0.00	0.02	0.00	0.00	0.00	2

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Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 1		Alternative 2		Alternative 1						Alternative 1					
		Steaming Hrs[1]	Steaming Hrs[1]	Steaming Hrs[1]	Steaming Hrs[1]	Annual Emissions in Tons						Restricted Waters Only Annual Emissions in Tons					
		Open Water	State Waters	Open Water	State Waters	CO	NOx	HC	SO_x	PM_{10}	CO^2	CO	NO_x	HC	SO_x	PM_{10}	CO^2
T-ATF	Northeast	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	527	11	816	16	4.92	28.26	0.57	2.12	0.25	974	0.07	0.77	0.01	0.06	0.01	27
	Cherry Pt	148	1	24	1	1.37	7.79	0.16	0.58	0.07	268	0.01	0.07	0.00	0.01	0.00	2
	JAX	204	3	0	0	1.90	10.85	0.22	0.81	0.09	374	0.02	0.21	0.00	0.02	0.00	7
	Key West	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	57	1	0	0	0.53	3.04	0.06	0.23	0.03	105	0.01	0.07	0.00	0.01	0.00	2

Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 2						Alternative 2					
		Annual Emissions in Tons						Restricted Waters Only Annual Emissions in Tons					
		CO	NO_x	HC	SO_x	PM_{10}	CO^2	CO	NO_x	HC	SO_x	PM_{10}	CO^2
CVN	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	1.06	14.48	0.27	1.20	0.10	592	0.00	0.03	0.00	0.00	0.00	1
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.64	8.64	0.16	0.72	0.06	353	0.00	0.01	0.00	0.00	0.00	0
	Key West	0.06	0.80	0.01	0.07	0.01	33	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	0.49	6.63	0.12	0.55	0.05	271	0.00	0.00	0.00	0.00	0.00	0
CG	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	125.13	172.00	8.81	114.33	4.94	51,597	1.12	11.56	0.10	4.45	0.41	2,828
	Cherry Pt	16.99	22.11	1.19	15.10	0.63	6,712	0.01	0.14	0.00	0.05	0.01	35
	JAX	104.55	139.50	7.35	94.08	3.98	42,118	0.47	4.85	0.04	1.87	0.17	1,187
	Key West	3.70	4.92	0.26	3.32	0.14	1,486	0.01	0.14	0.00	0.05	0.01	35
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	52.43	68.09	3.68	46.54	1.93	20,680	0.03	0.29	0.00	0.11	0.01	70
DG-1000	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	279.57	1,301.47	15.92	491.07	47.44	305,545	7.42	10.53	0.46	4.86	0.66	3,908
	Cherry Pt	22.90	108.56	1.30	40.89	3.94	25,371	0.02	0.03	0.00	0.01	0.00	12
	JAX	91.55	430.16	5.21	162.16	15.63	100,750	1.23	1.75	0.08	0.81	0.11	649
	Key West	1.63	7.65	0.09	2.88	0.28	1,792	0.02	0.03	0.00	0.01	0.00	12
	GOMEX	6.85	32.40	0.39	12.21	1.18	7,575	0.02	0.03	0.00	0.01	0.00	12
	Outside RCs	55.80	244.65	3.20	92.87	9.09	58,341	6.03	8.55	0.38	3.95	0.53	3,175
LCS	Northeast	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	77.32	307.53	5.37	81.16	11.05	41,691	2.57	4.96	0.20	0.76	0.24	361
	Cherry Pt	16.10	65.07	1.11	17.28	2.32	8,884	0.04	0.08	0.00	0.01	0.00	6
	JAX	211.19	847.33	14.63	224.38	30.35	115,306	3.56	6.87	0.28	1.05	0.33	500
	Key West	2.81	11.28	0.19	2.99	0.40	1,536	0.04	0.08	0.00	0.01	0.00	6
	GOMEX	2.81	11.28	0.19	2.99	0.40	1,536	0.04	0.08	0.00	0.01	0.00	6
	Outside RCs	219.42	843.26	15.34	219.45	30.64	112,580	21.20	40.90	1.64	6.24	1.98	2,979

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Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 2						Alternative 2					
		Annual Emissions in Tons						Restricted Waters Only Annual Emissions in Tons					
		CO	NO_x	HC	SO_x	PM_{10}	CO^2	CO	NO_x	HC	SO_x	PM_{10}	CO^2
LSD	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	26.46	415.91	13.50	30.61	2.66	20,024	0.96	14.50	0.49	1.09	0.05	507
	Cherry Pt	8.95	140.80	4.56	10.35	0.91	6,841	0.02	0.30	0.01	0.02	0.00	11
	JAX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	12.99	203.77	6.62	15.01	1.28	9,701	1.00	15.11	0.51	1.13	0.05	528
LHA	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0.07	2.36	0.12	0.57	0.07	305	0.00	0.14	0.01	0.03	0.00	18
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.01	0.42	0.02	0.10	0.01	54	0.00	0.14	0.01	0.03	0.00	18
	Outside RCs	0.10	3.24	0.17	0.78	0.10	419	0.00	0.14	0.01	0.03	0.00	18
LHD	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	9.59	56.62	6.84	113.56	33.82	56,560	0.18	0.94	0.12	2.84	0.57	1,116
	Cherry Pt	4.27	25.27	3.05	50.28	15.10	25,174	0.00	0.02	0.00	0.06	0.01	24
	JAX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	3.88	22.98	2.77	45.72	13.73	22,887	0.00	0.02	0.00	0.06	0.01	24
LPD	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	51.73	446.27	27.59	61.42	5.38	27,442	0.90	8.44	0.48	1.06	0.09	481
	Cherry Pt	14.05	121.02	7.49	16.68	1.46	7,452	0.01	0.13	0.01	0.02	0.00	8
	JAX	0.77	6.67	0.41	0.92	0.08	410	0.01	0.13	0.01	0.02	0.00	8
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	2.67	23.00	1.42	3.17	0.28	1,416	0.01	0.13	0.01	0.02	0.00	8
	Outside RCs	28.49	245.45	15.20	33.84	2.97	15,113	0.04	0.40	0.02	0.05	0.00	23
PC	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	1.39	0.38	0.03	0.08	0.01	39	0.04	0.08	0.01	0.02	0.00	8
	Cherry Pt	0.81	0.21	0.02	0.05	0.01	22	0.02	0.04	0.00	0.01	0.00	4
	JAX	7.60	1.84	0.15	0.41	0.06	190	0.11	0.19	0.02	0.04	0.01	20
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.41	0.13	0.01	0.03	0.00	13	0.02	0.04	0.00	0.01	0.00	4
	Outside RCs	3.67	0.84	0.07	0.19	0.03	87	0.02	0.04	0.00	0.01	0.00	4
JHSV	Northeast	2.16	4.20	0.10	0.64	0.20	306	0.05	0.10	0.00	0.02	0.00	7
	VACAPES	4.65	9.04	0.21	1.38	0.44	658	0.29	0.57	0.01	0.09	0.03	41
	Cherry Pt	0.24	0.47	0.01	0.07	0.02	34	0.05	0.10	0.00	0.02	0.00	7
	JAX	1.67	3.25	0.07	0.49	0.16	236	0.05	0.09	0.00	0.01	0.00	7
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	1.78	3.46	0.08	0.53	0.17	252	0.05	0.10	0.00	0.02	0.00	7
	Outside RCs	8.69	16.86	0.39	2.57	0.82	1,228	0.05	0.10	0.00	0.02	0.00	7

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Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 2						Alternative 2					
		Annual Emissions in Tons						*Restricted Waters Only Annual Emissions in Tons*					
		CO	*NO_x*	*HC*	*SO_x*	*PM_{10}*	*CO^2*	*CO*	*NO_x*	*HC*	*SO_x*	*PM_{10}*	*CO^2*
MV	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	7.70	150.95	4.21	13.12	2.31	5,740	0.00	0.09	0.00	0.04	0.01	18
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	1.07	20.91	0.58	1.83	0.32	800	0.00	0.04	0.00	0.02	0.01	9
SSGN	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.11	3.89	0.07	0.22	0.02	127	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.05	1.80	0.03	0.10	0.01	59	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	0.01	0.49	0.01	0.03	0.00	16	0.00	0.00	0.00	0.00	0.00	0
SSN	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0.41	3.14	0.17	0.59	0.10	281	0.00	0.01	0.00	0.00	0.00	1
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.12	0.87	0.05	0.16	0.03	78	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	1.26	9.62	0.51	1.81	0.31	861	0.04	0.33	0.00	0.07	0.00	29
T-AH	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	0.50	3.79	0.25	2.64	0.74	1,306	0.01	0.05	0.00	0.04	0.01	18
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	0.16	1.25	0.08	0.87	0.24	429	0.00	0.00	0.00	0.00	0.00	0
T-AKE	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	3.12	91.21	8.99	11.09	1.41	5,203	0.03	0.52	0.07	0.07	0.01	32
	Cherry Pt	0.74	21.81	2.15	2.65	0.34	1,244	0.00	0.04	0.01	0.01	0.00	3
	JAX	0.99	29.11	2.87	3.54	0.45	1,660	0.01	0.09	0.01	0.01	0.00	5
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	19.99	587.88	57.82	71.46	9.08	33,518	0.01	0.17	0.02	0.02	0.00	11
T-AO	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.02	0.27	0.01	0.02	0.00	8
	VACAPES	60.80	842.72	27.50	55.85	4.95	24,669	0.75	11.31	0.38	0.82	0.07	325
	Cherry Pt	16.09	222.76	7.27	14.74	1.31	6,522	0.04	0.54	0.02	0.04	0.00	15
	JAX	27.39	379.48	12.38	25.13	2.23	11,110	0.18	2.69	0.09	0.20	0.02	77
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.02	0.27	0.01	0.02	0.00	8
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.02	0.27	0.01	0.02	0.00	8
	Outside RCs	146.60	2,029.70	66.21	134.33	11.90	59,430	0.04	0.54	0.02	0.04	0.00	15

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Tab D Table 1. Vessel Steaming Hours by State vs International Waters and by OPAREA (continued)

		Alternative 2						*Alternative 2*					
		Annual Emissions in Tons						*Restricted Waters Only Annual Emissions in Tons*					
		CO	*NO_x*	*HC*	*SO_x*	*PM_{10}*	*CO^2*	*CO*	*NO_x*	*HC*	*SO_x*	*PM_{10}*	*CO^2*
T-AOE	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	128.59	372.84	12.48	101.19	9.97	9,766	0.82	10.46	0.14	3.15	0.29	1,915
	Cherry Pt	34.26	97.35	3.31	26.35	2.60	2,145	0.02	0.22	0.00	0.07	0.01	41
	JAX	14.54	41.76	1.41	11.32	1.12	1,013	0.05	0.67	0.01	0.20	0.02	122
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
T-ARS	Northeast	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0
	VACAPES	1.18	11.86	0.46	2.49	0.33	1,256	0.02	0.27	0.01	0.06	0.00	28
	Cherry Pt	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	JAX	0.16	1.57	0.06	0.33	0.04	166	0.00	0.02	0.00	0.00	0.00	2
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	4.46	44.89	1.77	9.44	1.24	4,754	0.01	0.06	0.00	0.01	0.00	6
T-ATF	Northeast	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	VACAPES	7.62	43.68	0.88	3.27	0.38	1,505	0.11	1.12	0.02	0.08	0.01	39
	Cherry Pt	0.23	1.32	0.03	0.10	0.01	46	0.01	0.07	0.00	0.01	0.00	2
	JAX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Key West	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	GOMEX	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0
	Outside RCs	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00	0

[1] Steaming hours provided by the US Navy, AFTT Gray Ship Steaming Hours for Air Analysis.docx, 12 September, 2016.

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Tab E: Training in State Waters

Tab E Table 1. State Waters Activities[1]

Total Annual Hours									
Vessel Type	*NE - Naragansett*	*VACAPES*	*Ches Bay + Tribe*	*Charleston*	*JAX /St Johns/ Mayport*	*Cape Canaveral/ SE FL*	*St. Andrews Bay / Panama City*	*Key West*	*GOMEX/ Corpus Christie*
RCB	1,616	0	14,072	0	0	2,676	0	0	0
RAB	1,616	0	16,204	0	0	2,676	0	0	0
RPB	1,616	0	23,752	0	0	2,676	0	0	0
SEA ARK	7,886	0	16,352	12,651	225	2,676	0	0	0
LCAC	0	3,278	8,013	0	750	0	0	0	0
LCU/LCM	0	1,080	1,426	0	0	0	0	0	0
RIB (Zodiac)	0	2,910	9,159	0	381	0	75	0	0
Mark V	0	660	2,987	0	200	0	75	0	0
CRRC	0	228	2,111	0	200	0	75	0	0
T-ATF	0	250	680	0	0	0	0	0	0
T-ARS	0	250	680	0	0	0	0	0	0
HSMST	0	0	36	0	0	0	0	0	0

[1] State water activities provided by US Navy, AFTT Inshore Events_08Feb2017_NAEMO WEB.xlsx

Emissions by Area

Tab E Table 2. Vessel Type NE - Naragansett Bay, RI

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	0.91	2.27	22.14	3.30	0.53	1,286
RAB	0.47	1.18	11.46	1.70	0.27	677
RPB	0.47	1.18	11.46	1.70	0.27	677
SEA ARK	2.21	5.48	53.39	7.96	1.30	2,913
LCAC (SSGTG/MPGT)(80/3955)	0	0	0	0	0	0
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0	0	0	0	0	0
Mark V	0	0	0	0	0	0
CRRC	0	0	0	0	0	0
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**4.1**	**10.1**	**98.4**	**14.7**	**2.4**	**5,552**

Tab E Table 3. Vessel Type VA Capes

	VOC	**CO**	**NO_x**	**SO_x**	**$PM_{10}/PM_{2.5}$**	**CO_2**
RCB	0	0	0	0	0	0
RPB	0	0	0	0	0	0
RAB	0	0	0	0	0	0
SEA ARK	0	0	0	0	0	0
LCAC	0.57	2.02	4.80	0.62	0.41	1,094
LCU/LCM	0.28	19.55	24.27	1.68	0.85	909
RIB (Zodiac)	0.09	0.49	13.30	2.10	0.22	1,693
Mark V	2.26	8.98	27.86	3.62	1.26	1,780
CRRC	0.00	0.03	0.11	0.00	0.00	10
T-ATF	0.26	2.30	13.04	0.98	0.11	449
T-ARS	0.16	0.40	4.03	0.85	0.11	426
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**3.6**	**33.8**	**87.4**	**9.8**	**3.0**	**6,363**

Tab E Table 4. Chesapeake Bay & Tributaries

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	7.91	19.78	192.79	28.70	4.65	11,195
RPB	4.08	10.27	99.77	14.85	2.39	5,893
RAB	4.08	10.27	99.77	14.85	2.39	5,893
SEA ARK	3.94	9.78	95.26	14.21	2.32	5,198
LCAC	1.40	4.93	11.74	1.52	1.00	2,674
LCU/LCM	0.37	25.82	32.05	2.22	1.12	1,201
RIB (Zodiac)	0.27	1.56	41.86	6.59	0.69	5,330
Mark V	10.23	40.62	126.08	16.37	5.69	8,057
CRRC	0.01	0.24	1.01	0.00	0.03	92
T-ATF	0.72	6.26	35.47	2.66	0.31	1,222
T-ARS	0.43	1.09	10.95	2.30	0.30	1,160
HSMST	3.65	8.88	0.13	0.00	0.01	8
Total Emissions in Tons	**37.1**	**139.5**	**746.9**	**104.3**	**20.9**	**47,922**

Tab E Table 5. Vessel Type Charleston

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	0	0	0	0	0	0
RPB	0	0	0	0	0	0
RAB	0	0	0	0	0	0
SEA ARK	3.54	8.79	85.65	12.78	2.09	4673
LCAC	0	0	0	0	0	0
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0	0	0	0	0	0
Mark V	0	0	0	0	0	0
CRRC	0	0	0	0	0	0
BW	0	0	0	0	0	0
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**3.5**	**8.8**	**85.6**	**12.8**	**2.1**	**4,673**

Tab E Table 6. Vessel Type JAX/ St John/ Mayport

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	0	0	0	0	0	0
RPB	0	0	0	0	0	0
RAB	0	0	0	0	0	0
SEA ARK	0.06	0.16	1.52	0.23	0.04	83
LCAC	0.13	0.46	1.10	0.14	0.09	250
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0.01	0.06	1.74	0.27	0.03	222
Mark V	0.69	2.72	8.44	1.10	0.38	540
CRRC	0.00	0.02	0.10	0.00	0.00	9
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**0.9**	**3.4**	**12.9**	**1.7**	**0.5**	**1,103**

Tab E Table 7. Vessel Type Cape Canaveral/ SE FL

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	1.50	3.76	36.66	5.46	0.88	2,129
RPB	0.78	1.95	18.97	2.82	0.45	1,121
RAB	0.78	1.95	18.97	2.82	0.45	1,121
SEA ARK	0.75	1.86	18.12	2.70	0.44	988
LCAC	0	0	0	0	0	0
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0	0	0	0	0	0
Mark V	0	0	0	0	0	0
CRRC	0	0	0	0	0	0
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**3.81**	**9.53**	**92.73**	**13.81**	**2.23**	**5,359**

Tab E Table 8. Vessel Type Panama City

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	0	0	0	0	0	0
RPB	0	0	0	0	0	0
RAB	0	0	0	0	0	0
SEA ARK	0	0	0	0	0	0
LCAC	0	0	0	0	0	0
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0.00	0.01	0.34	0.05	0.01	44
Mark V	0.26	1.02	3.17	0.41	0.14	202
CRRC	0.00	0.01	0.04	0.00	0.00	3
BW	0	0	0	0	0	0
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**0.3**	**1.0**	**3.5**	**0.5**	**0.1**	**249**

Tab E Table 9. Vessel Type Key West

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	0	0	0	0	0	0
RPB	0	0	0	0	0	0
RAB	0	0	0	0	0	0
SEA ARK	0	0	0	0	0	0
LCAC	0	0	0	0	0	0
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0	0	0	0	0	0
Mark V	0	0	0	0	0	0
CRRC	0	0	0	0	0	0
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0**

Tab E Table 10. Vessel Type GOMEX/ Corpus Christie

	VOC	*CO*	*NO_x*	*SO_x*	*$PM_{10}/PM_{2.5}$*	*CO_2*
RCB	0	0	0	0	0	0
RPB	0	0	0	0	0	0
RAB	0	0	0	0	0	0
SEA ARK	0	0	0	0	0	0
LCAC	0	0	0	0	0	0
LCU/LCM	0	0	0	0	0	0
RIB (Zodiac)	0	0	0	0	0	0
Mark V	0	0	0	0	0	0
CRRC	0	0	0	0	0	0
BW	0	0	0	0	0	0
T-ATF	0	0	0	0	0	0
T-ARS	0	0	0	0	0	0
HSMST	0	0	0	0	0	0
Total Emissions in Tons	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0**

[1] State water activities provided by US Navy, AFTT Inshore Events_08Feb2017_NAEMO WEB.xlsx

Tab F: Inland Water Training Events and Locations[1]

Tab F Table 1. Inland Water Training Events and Locations

Event	Locations		Hours	Boat Type
Amphibious Vehicle Maneuvers				
	LCB	VA	1426	LCU
			8013	LCAC
			3390	RHIB
	VACAPES		1080	LCU
			3278	LCAC
			228	RHIB
Dive and Salvage				
	LCB	VA	780	RHIB
			780	CRRC
			780	MK V
	JR & Tributaries	VA	30	RHIB
			15	MK V
	NS Mayport	FL	160	RHIB
			160	MK V
			160	CRRC
Personnel Insertion/Extraction - Air				
	LCB	VA		
			358	CRRC
			701	RHIB
	JR & Tributaries	VA	595	RHIB
			595	CRRC
	YR	VA	44	RHIB
			12	CRRC
	VA CAPES	VA	220	RHIB
			108	CRRC
	NS Mayport	FL	40	RHIB
			40	CRRC
			40	MK V
	St Andrews Bay	FL	75	RHIB
			75	MK V
			75	CRRC
	St Johns River	FL	131	RHIB
			750	LCAC

Tab F Table 1. Inland Water Training Events and Locations (continued)

Personnel Insertion/Extraction -				
Surface and Subsurface				
	LCB	VA	112	CRRC
			168	RHIB
			3,198	RCB
			11,178	RPB
			3,198	SEA ARK
			3,198	RAB
	JR & Tributaries	VA	504	RHIB
			3734	RPB
			3734	RAB
			2034	RCB
			1530	SEA ARK
	YR	VA	1960	RPB
			1960	RAB
			1960	RCB
			1960	SEA ARK
U/W Mine Countermeasure				
	LCB	VA		
			1,647	RHIB
			1,647	RPB
			1,647	MK V
			505	T-ATF
			505	T-ARS
	JR & Tributaries	VA	545	RHIB
			545	MK V
	YR	VA	175	T-ATF
			175	T-ARS
			156	RHIB
	VA CAPES	VA	250	T-ATF
			250	T-ARS
			740	RHIB
			660	MK V
			120	CRRC
Maritime Security Operations	LCB	VA	135	RHIB
			2352	RAB
			4704	SEA ARK
			7	HSMST

Tab F Table 1. Inland Water Training Events and Locations (continued)

	NSN	VA	216	RHIB
			28.75	HSMST
	JR & Tributaries	VA	7,920	SEA ARK
	VA CAPES	VA	162	RHIB
	NS Mayport	FL	50	RHIB
	Naragansett Bay	RI	1616	RPB
			1616	RAB
			1616	RCB
			1616	SEA ARK
	Port Canaveral	FL	2676	RPB
			2676	RAB
			2676	RCB
			2676	SEA ARK
Precision Anchoring	JR & Tributaries	VA	150	RHIB
Search and Rescue	JR & Tributaries	VA	25	RHIB
	VA CAPES	VA	1560	RHIB
	NS Mayport	FL	28	RHIB
Waterborne Training	JR & Tributaries	VA	2880	RPB
			2880	RAB
			2880	RCB
			2880	SEA ARK
	LCB	VA		
			74	RHIB
			266	CRRC
			3040	RPB
			1120	RAB
			1120	RCB
			1120	SEA ARK
	YR		960	RPB
			960	RAB
			2880	RCB
			960	SEA ARK
	NS Mayport	FL	225	SEA ARK
	Narragansett Bay	RI	6270	SEA ARK
	Cooper River	SC	12651	SEA ARK

[1] State water activities provided by US Navy, *AFTT Inshore Events_08Feb2017_NAEMO WEB.xlsx*

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Tab G: Aircraft Emissions

Tab G Table 1. Training Aircraft Operational Hours below 3,000 Ft (except for GHG) by OPAREA (all activities in international waters)

		Alternative 1		*Alternative 2*		*Alternative 1*						*Alternative 2*					
			Cruise[1]		*Cruise[1]*	*Annual Emissions in Tons*						*Annual Emissions in Tons*					
		LTOs (#)[1]	(Hrs)	LTOs (#)[1]	(Hrs)	VOC	CO	NOx	SO_2	$PM_{10/2.5}$	CO^2e	VOC	CO	NOx	SO_2	$PM_{10/2.5}$	CO^2e
	VACAPES	58	37	58	37	1.63	6.97	1.69	0.42	1.18	583	1.63	6.97	1.69	0.42	1.18	583
	GOMEX		5		5	0.01	0.04	0.11	0.04	0.10	52	0.01	0.04	0.11	0.04	0.10	52
	JAX	491	41	491	41	13.34	57.07	8.27	1.53	4.25	2092	13.34	57.07	8.27	1.53	4.25	2,092
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F-18/EA-18G	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	157	24	157	24	4.29	18.34	2.90	0.57	1.60	787	4.29	18.34	2.90	0.57	1.60	787
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	58	37	58	37	0.25	18.61	9.22	2.36	1.30	3713	0.25	18.61	9.22	2.36	1.30	3,713
	GOMEX		5		5	0.03	2.43	1.11	0.31	0.17	467	0.03	2.43	1.11	0.31	0.17	467
	JAX	491	41	491	41	0.38	24.13	17.01	3.10	1.47	5759	0.38	24.13	17.01	3.10	1.47	5,759
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F-35	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	157	24	157	24	0.19	13.24	7.97	1.69	0.87	2905	0.19	13.24	7.97	1.69	0.87	2,905
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MV-22	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	110		110		0.00	0.17	0.39	0.11	0.07	163.4	0.00	0.17	0.39	0.11	0.07	163.41
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES		15		15	0.02	0.07	0.31	0.08	0.15	119	0.02	0.07	0.31	0.08	0.15	119
	GOMEX		15		15	0.02	0.07	0.31	0.08	0.15	119	0.02	0.07	0.31	0.08	0.15	119
	JAX		53		53	0.06	0.23	1.07	0.28	0.51	410	0.06	0.23	1.07	0.28	0.51	410
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-3	Northeast		8		8	0.01	0.03	0.16	0.04	0.08	61	0.01	0.03	0.16	0.04	0.08	61
	Cherry Pt		4		4	0.00	0.02	0.08	0.02	0.04	31	0.00	0.02	0.08	0.02	0.04	31
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES		64		64	0.08	1.10	7.45	0.77		1088	0.08	1.10	7.45	0.77	0.00	1,088
	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX		185		185	0.23	3.17	21.40	2.20		3124	0.23	3.17	21.40	2.20	0.00	3,124
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-8	Northeast		42		42	0.05	0.73	4.91	0.51		718	0.05	0.73	4.91	0.51	0.00	718
	Cherry Pt		16		16	0.02	0.28	1.89	0.19		276	0.02	0.28	1.89	0.19	0.00	276
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Tab G Table 1. Training Aircraft Operational Hours below 3,000 Ft (except for GHG) by OPAREA (all activities in international waters) (continued)

		Alternative 1		*Alternative 2*		*Alternative 1*						*Alternative 2*					
			Cruise[1]		*Cruise*[1]	*Annual Emissions in Tons*						*Annual Emissions in Tons*					
		LTOs (#)[1]	**(Hrs)**	**LTOs (#)**[1]	**(Hrs)**	**VOC**	**CO**	**NOx**	**SO_2**	**$PM_{10/2.5}$**	**CO^2e**	**VOC**	**CO**	**NOx**	**SO_2**	**$PM_{10/2.5}$**	**CO^2e**
AV-8B	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	107	3	107	3	0.50	2.64	0.49	0.15	0.41	211	0.50	2.64	0.49	0.15	0.41	211
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	64	14,149	64	19,914	5.41	53.36	54.41	18.88	35.70	27395	7.60	74.97	76.54	26.56	50.23	38,534
H-60	GOMEX		2,469		2,517	0.94	9.25	9.48	3.29	6.22	4770	0.95	9.43	9.66	3.35	6.34	4,863
	JAX	129	2,447	129	3,107	1.02	9.80	9.57	3.33	6.28	4836	1.27	12.28	12.10	4.21	7.94	6,111
	Key West		243		816	0.09	0.91	0.93	0.32	0.61	470	0.31	3.06	3.13	1.09	2.06	1,577
	Northeast		1,843		3,315	0.70	6.91	7.07	2.45	4.64	3561	1.26	12.43	12.73	4.41	8.35	6,405
	Cherry Pt	234	612	234	612	0.40	3.43	2.67	0.95	1.75	1377	0.40	3.43	2.67	0.95	1.75	1,377
	Panama City		2,252		2,664	0.85	8.44	8.65	3.00	5.67	4352	1.01	9.99	10.23	3.55	6.71	5,148
	VACAPES		1,812			0.42	8.35	85.02	0.00	0.61	13807	0.42	8.35	85.02	0.00	0.61	13,807
H-53	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX		342			0.08	1.58	16.05	0.00	0.12	2607	0.08	1.58	16.05	0.00	0.12	2,607
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt		250			0.06	1.15	11.73	0.00	0.08	1905	0.06	1.15	11.73	0.00	0.08	1,905
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES		398			0.02	0.14	0.80	0.31	0.58	442	0.02	0.14	0.80	0.31	0.58	442
UH-1	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX		118			0.01	0.04	0.24	0.09	0.17	131	0.01	0.04	0.24	0.09	0.17	131
	Key West		24			0.00	0.01	0.05	0.02	0.03	27	0.00	0.01	0.05	0.02	0.03	27
	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt		27			0.00	0.01	0.05	0.02	0.04	30	0.00	0.01	0.05	0.02	0.04	30
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AH-1	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX		2			0.00	0.01	0.00	0.00	0.00	3	0.00	0.01	0.00	0.00	0.00	3
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt		5			0.00	0.02	0.01	0.00	0.01	7	0.00	0.02	0.01	0.00	0.01	7
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES		13			0.00	0.02	0.15	0.02	0.00	31	0.00	0.02	0.15	0.02	0.00	31
Learjet	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Tab G Table 1. Training Aircraft Operational Hours below 3,000 Ft (except for GHG) by OPAREA (all activities in international waters) (continued)

		Alternative 1		*Alternative 2*		*Alternative 1*						*Alternative 2*					
			Cruise[1]		*Cruise[1]*	*Annual Emissions in Tons*						*Annual Emissions in Tons*					
		LTOs (#)[1]	(Hrs)	LTOs (#)[1]	(Hrs)	VOC	CO	NOx	SO_2	$PM_{10/2.5}$	CO^2e	VOC	CO	NOx	SO_2	$PM_{10/2.5}$	CO^2e
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Tab G Table 2. Aircraft Operational Hours below 3,000 Ft (except for GHG) by OPAREA (all activities in state waters)

		Alternative 1							*Alternative 2*						
		Cruise[1]	*Annual Emissions in Tons*						*Cruise*	*Annual Emissions in Tons*					
		(Hrs)	*VOC*	*CO*	*NOx*	*SO2*	*$PM_{10/2.5}$*	*CO2e*	*(Hrs)*	*VOC*	*CO*	*NOx*	*SO2*	*$PM_{10/2.5}$*	*CO2e*
H-60	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	2,489	0.94	9.33	9.56	3.31	6.27	4810	2,489	0.94	9.33	9.56	3.31	6.27	4,810
	Cherry Pt	2	0.00	0.01	0.01	0.00	0.01	5	2	0.00	0.01	0.01	0.00	0.01	5
	JAX	159	0.06	0.60	0.61	0.21	0.40	307	159	0.06	0.60	0.61	0.21	0.40	307
	Key West									0.00	0.00	0.00	0.00	0.00	0
	GOMEX	20	0.01	0.07	0.08	0.03	0.05	39	20	0.01	0.07	0.08	0.03	0.05	39
	Panama City	2,252	0.85	8.44	8.65	3.00	5.67	4352	2,664	1.01	9.99	10.23	3.55	6.71	5,148
H-53	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	392	0.09	1.81	18.40	0.00	0.13	2988	392	0.09	1.81	18.40	0.00	0.13	2,988
	Cherry Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0
UH-1	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AH-1	Northeast	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VACAPES	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cherry Pt	22	11.83	193.56	101.92	40.77	77.13	59060	22	11.83	193.56	101.92	40.77	77.13	59,060
	JAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Key West	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	GOMEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Panama City	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] LTOs and Cruise time from US Navy, NAVAIR Assumptions.docx, Marine Corps Training Cycle.xlsx, C2X sorties hours.xlsx, IKE C2X.xlsx. AFTT Training Air Analysis.xlsx.

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Tab H: Munition Emissions

Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1]

Category	*Location – Range Complex*	*Number of Items (Annual) for Training & Testing Activities*	*Number of Items (Annual) for Training & Testing Activities*	*Emission Factors (lb/item)*								*Emissions (lb/year) Alternative 1*							
		Alternative 1	*Alternative 2*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*Pb*
Bombs																			
Bombs (High Explosive)	Northeast / NUWC Newport	0	0	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Virginia Capes	92	92	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	5612.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cherry Pt.	0	0	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Jacksonville	56	56	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3416.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Key West	0	0	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	4	4	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	244.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other AFTT	12	12	61.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	732.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**164**	**164**																
Projectiles																			
Small Caliber (Non-Explosive Practice Munitions)	Northeast / NUWC Newport	31,800	31,800	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	57.24	0.89	0.00	0.00	3.12	2.80	66.78	0.38
	Virginia Capes	2,344,800	2,344,800	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	4220.64	65.65	0.00	0.00	229.79	206.34	4924.08	28.14
	Cherry Pt.	397,800	397,800	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	716.04	11.14	0.00	0.00	38.98	35.01	835.38	4.77
	Jacksonville	1,035,800	1,035,800	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	1864.44	29.00	0.00	0.00	101.51	91.15	2175.18	12.43
	Key West	4,800	4,800	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	8.64	0.13	0.00	0.00	0.47	0.42	10.08	0.06
	GOMEX / NSWC Panama City	107,800	107,800	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	194.04	3.02	0.00	0.00	10.56	9.49	226.38	1.29
	Other AFTT	100,000	100,000	0.00	2.80E-05	0.00	0.00	9.80E-05	8.80E-05	0.00	1.20E-05	180.00	2.80	0.00	0.00	9.80	8.80	210.00	1.20
	Total	4,022,800	4,022,800																

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Category	Location – Range Complex	Number of Items (Annual) for Training & Testing Activities	Number of Items (Annual) for Training & Testing Activities	Emission Factors (lb/item)								Emissions (lb/year) Alternative 1							
		Alternative 1	Alternative 2	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO^2	Pb	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2	Pb
Medium Caliber (High Explosive)	Northeast / NUWC Newport	3,860	3,860	0.085	0.0015	0.0000	0.0000	0.0033	0.0017	0.043	0.000049	328.10	5.79	0.00	0.00	12.74	6.56	165.98	0.19
	Virginia Capes	63,370	63,370	0.085	0.0015	0.0000	0.0000	0.0033	0.0017	0.043	0.000049	5386.45	95.06	0.00	0.00	209.12	107.73	2724.91	3.11
	Cherry Pt.	23,360	23,360	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.000049	1985.60	35.04	0.00	0.00	77.09	39.71	1004.48	1.14
	Jacksonville	60,460	60,460	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.000049	5139.10	90.69	0.00	0.00	199.52	102.78	2599.78	2.96
	Key West	3,360	3,360	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.000049	285.60	5.04	0.00	0.00	11.09	5.71	144.48	0.16
	GOMEX / NSWC Panama City	9,360	9,360	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.000049	795.60	14.04	0.00	0.00	30.89	15.91	402.48	0.46
	Other AFTT	0	0	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.000049	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	163,770	163,770																
Medium Caliber (Non-Explosive Practice Munitions)	Northeast / NUWC Newport	10,060	10,060	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	855.10	15.09	0.00	0.00	33.20	17.10	432.58	0.49
	Virginia Capes	893,226	893,226	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	75924.21	1339.84	0.00	0.00	2947.65	1518.48	38408.72	43.77
	Cherry Pt.	336,309	336,309	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	28586.27	504.46	0.00	0.00	1109.82	571.73	14461.29	16.48
	Jacksonville	621,221	621,221	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	52803.79	931.83	0.00	0.00	2050.03	1056.08	26712.50	30.44
	Key West	60,660	60,660	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	5156.10	90.99	0.00	0.00	200.18	103.12	2608.38	2.97
	GOMEX / NSWC Panama City	56,910	56,910	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	4837.35	85.37	0.00	0.00	187.80	96.75	2447.13	2.79
	Other AFTT	21,150	21,150	0.0850	0.0015	0.0000	0.0000	0.0033	0.0017	0.0430	0.0000	1797.75	31.73	0.00	0.00	69.80	35.96	909.45	1.04
	Total	1,999,536	1,999,536																
Large Caliber (High Explosive)	Northeast / NUWC Newport	1,632	1,632	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	158.30	26.11	0.00	0.00	277.44	151.78	2284.80	1.13
	Virginia Capes	5,525	5,525	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	535.93	88.40	0.00	0.00	939.25	513.83	7735.00	3.81
	Cherry Pt.	1,842	1,842	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	178.67	29.47	0.00	0.00	313.14	171.31	2578.80	1.27
	Jacksonville	8,518	8,518	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	826.25	136.29	0.00	0.00	1448.06	792.17	11925.20	5.88
	Key West	2,332	2,332	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	226.20	37.31	0.00	0.00	396.44	216.88	3264.80	1.61
	GOMEX / NSWC Panama City	2,637	2,637	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	255.79	42.19	0.00	0.00	448.29	245.24	3691.80	1.82
	Other AFTT	114	114	0.0970	0.0160	0.0000	0.0000	0.1700	0.0930	1.4000	0.0007	11.06	1.82	0.00	0.00	19.38	10.60	159.60	0.08
	Total	22,600	22,600																

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Category	*Location – Range Complex*	*Number of Items (Annual) for Training & Testing Activities*	*Number of Items (Annual) for Training & Testing Activities*	*Emission Factors (lb/item)*								*Emissions (lb/year) Alternative 1*							
		Alternative 1	*Alternative 2*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*Pb*
Large Caliber (Non-Explosive Practice Munition)	Northeast / NUWC Newport	1,761	1,761	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Virginia Capes	13,077	13,077	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Cherry Pt.	3,714	3,714	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Jacksonville	17,058	17,058	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Key West	3,190	3,190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	3,552	3,552	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other AFTT	210	210	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	42,562	42,562																
Rockets (High Explosive)	Northeast / NUWC Newport	0	0	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Virginia Capes	1,954	1,954	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	2931.00	50.80	0.00	0.00	214.94	195.40	4689.60	99.65
	Cherry Pt.	76	76	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	114.00	1.98	0.00	0.00	8.36	7.60	182.40	3.88
	Jacksonville	2,024	2,024	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	3036.00	52.62	0.00	0.00	222.64	202.40	4857.60	103.22
	Key West	0	0	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	190	190	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	285.00	4.94	0.00	0.00	20.90	19.00	456.00	9.69
	Other AFTT	0	0	1.5000	0.0260	0.0000	0.0000	0.1100	0.1000	2.4000	0.0510	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	4,244	4,244																
Rockets (Non-Explosive)	Northeast / NUWC Newport	2	2	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	1.06	0.00	0.00	0.00	0.32	0.34	9.60	0.14
	Virginia Capes	2,938	2,938	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	1557.14	0.00	0.00	0.00	470.08	499.46	14102.40	205.66
	Cherry Pt.	304	304	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	161.12	0.00	0.00	0.00	48.64	51.68	1459.20	21.28
	Jacksonville	2,748	2,748	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	1456.44	0.00	0.00	0.00	439.68	467.16	13190.40	192.36
	Key West	0	0	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	192	192	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	101.76	0.00	0.00	0.00	30.72	32.64	921.60	13.44
	Other AFTT	0	0	0.5300	0.0000	0.0000	0.0000	0.1600	0.1700	4.8000	0.0700	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	6,184	6,184																

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Category	Location – Range Complex	Number of Items (Annual) for Training & Testing Activities	Number of Items (Annual) for Training & Testing Activities	Emission Factors (lb/item)								Emissions (lb/year) Alternative 1							
		Alternative 1	Alternative 2	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO^2	Pb	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2	Pb
Pyrotechnic Buoys (e.g. MK-58 Marine Marker)	Northeast / NUWC Newport	0	0	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Virginia Capes	1,022	1,022	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	909.58	2.86	22.48	3.27	30660.00	23506.00	521.22	16.35
	Cherry Pt.	332	332	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	295.48	0.93	7.30	1.06	9960.00	7636.00	169.32	5.31
	Jacksonville	1,060	1,060	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	943.40	2.97	23.32	3.39	31800.00	24380.00	540.60	16.96
	Key West	30	30	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	26.70	0.08	0.66	0.10	900.00	690.00	15.30	0.48
	GOMEX / NSWC Panama City	53	53	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	47.17	0.15	1.17	0.17	1590.00	1219.00	27.03	0.85
	Other AFTT	24	24	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	21.36	0.07	0.53	0.08	720.00	552.00	12.24	0.38
	Total	2,521	2,521																
Grenades	Northeast / NUWC Newport	56	56	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	Virginia Capes	4,070	4,070	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	Cherry Pt.	28	28	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	Jacksonville	28	28	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	Key West	0	0	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	GOMEX / NSWC Panama City	28	28	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	Other AFTT	0	0	0.0008	0.0007	0.0000	0.0260	0.0700	0.0490	0.0110	0.0000	0.04	0.04	0.00	1.38	3.71	2.60	0.58	0.00
	Total	4,210	4,210																
Flares (countermeasure)	Northeast / NUWC Newport	0	0	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	Virginia Capes	21,235	21,235	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	Cherry Pt.	22,348	22,348	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	Jacksonville	38,048	38,048	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	Key West	31,008	31,008	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	GOMEX / NSWC Panama City	2,440	2,440	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	Other AFTT	0	0	0.0013	0.0001	0.0004	0.0000	0.0062	0.0062	0.0110	0.0000	0.07	0.01	0.02	0.00	0.33	0.33	0.58	0.00
	Total	115,079	115,079																

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Category	Location – Range Complex	Number of Items (Annual) for Training & Testing Activities	Number of Items (Annual) for Training & Testing Activities	Emission Factors (lb/item)								Emissions (lb/year) Alternative 1							
		Alternative 1	Alternative 2	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO^2	Pb	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO_2	Pb
Illumination Flares	Northeast / NUWC Newport	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Virginia Capes	40	40	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.44	0.12	0.01	0.00	4.80	4.80	5.60	0.00
	Cherry Pt.	48	48	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.53	0.15	0.02	0.00	5.76	5.76	6.72	0.00
	Jacksonville	48	48	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.53	0.15	0.02	0.00	5.76	5.76	6.72	0.00
	Key West	8	8	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.09	0.02	0.00	0.00	0.96	0.96	1.12	0.00
	GOMEX / NSWC Panama City	28	28	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.31	0.09	0.01	0.00	3.36	3.36	3.92	0.00
	Other AFTT	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	172	172																

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 1								*Emissions (lb/year) Alternative 2*							
CO	*NOx*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5612.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3416.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	244.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	732.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.24	0.89	0.00	0.00	3.12	2.80	66.78	0.38
2.1	0.0	0.0	0.0	0.1	0.1	2.5	0.0	4220.64	65.65	0.00	0.00	229.79	206.34	4924.08	28.14
0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	716.04	11.14	0.00	0.00	38.98	35.01	835.38	4.77
0.9	0.0	0.0	0.0	0.1	0.0	1.1	0.0	1864.44	29.00	0.00	0.00	101.51	91.15	2175.18	12.43
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.64	0.13	0.00	0.00	0.47	0.42	10.08	0.06
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	194.04	3.02	0.00	0.00	10.56	9.49	226.38	1.29
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	180.00	2.80	0.00	0.00	9.80	8.80	210.00	1.20
3.6	**0.1**	**0.0**	**0.0**	**0.2**	**0.2**	**4.2**	**0.0**								
0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	328.10	5.79	0.00	0.00	12.74	6.56	165.98	0.19
2.7	0.0	0.0	0.0	0.1	0.1	1.4	0.0	5386.45	95.06	0.00	0.00	209.12	107.73	2724.91	3.11
1.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1985.60	35.04	0.00	0.00	77.09	39.71	1004.48	1.14
2.6	0.0	0.0	0.0	0.1	0.1	1.3	0.0	5139.10	90.69	0.00	0.00	199.52	102.78	2599.78	2.96
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	285.60	5.04	0.00	0.00	11.09	5.71	144.48	0.16
0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	795.60	14.04	0.00	0.00	30.89	15.91	402.48	0.46
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.0	**0.1**	**0.0**	**0.0**	**0.3**	**0.1**	**3.5**	**0.0**								
0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	855.10	15.09	0.00	0.00	33.20	17.10	432.58	0.49
38.0	0.7	0.0	0.0	1.5	0.8	19.2	0.0	75924.21	1339.84	0.00	0.00	2947.65	1518.48	38408.72	43.77
14.3	0.3	0.0	0.0	0.6	0.3	7.2	0.0	28586.27	504.46	0.00	0.00	1109.82	571.73	14461.29	16.48

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 1								*Emissions (lb/year) Alternative 2*							
CO	***NOx***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
26.4	0.5	0.0	0.0	1.0	0.5	13.4	0.0	52803.79	931.83	0.00	0.00	2050.03	1056.08	26712.50	30.44
2.6	0.0	0.0	0.0	0.1	0.1	1.3	0.0	5156.10	90.99	0.00	0.00	200.18	103.12	2608.38	2.97
2.4	0.0	0.0	0.0	0.1	0.0	1.2	0.0	4837.35	85.37	0.00	0.00	187.80	96.75	2447.13	2.79
0.9	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1797.75	31.73	0.00	0.00	69.80	35.96	909.45	1.04
85.0	**1.5**	**0.0**	**0.0**	**3.3**	**1.7**	**43.0**	**0.0**								
0.1	0.0	0.0	0.0	0.1	0.1	1.1	0.0	158.30	26.11	0.00	0.00	277.44	151.78	2284.80	1.13
0.3	0.0	0.0	0.0	0.5	0.3	3.9	0.0	535.93	88.40	0.00	0.00	939.25	513.83	7735.00	3.81
0.1	0.0	0.0	0.0	0.2	0.1	1.3	0.0	178.67	29.47	0.00	0.00	313.14	171.31	2578.80	1.27
0.4	0.1	0.0	0.0	0.7	0.4	6.0	0.0	826.25	136.29	0.00	0.00	1448.06	792.17	11925.20	5.88
0.1	0.0	0.0	0.0	0.2	0.1	1.6	0.0	226.20	37.31	0.00	0.00	396.44	216.88	3264.80	1.61
0.1	0.0	0.0	0.0	0.2	0.1	1.8	0.0	255.79	42.19	0.00	0.00	448.29	245.24	3691.80	1.82
0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	11.06	1.82	0.00	0.00	19.38	10.60	159.60	0.08
1.1	**0.2**	**0.0**	**0.0**	**1.9**	**1.1**	**15.8**	**0.0**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.5	0.0	0.0	0.0	0.1	0.1	2.3	0.0	2931.00	50.80	0.00	0.00	214.94	195.40	4689.60	99.65
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	114.00	1.98	0.00	0.00	8.36	7.60	182.40	3.88
1.5	0.0	0.0	0.0	0.1	0.1	2.4	0.1	3036.00	52.62	0.00	0.00	222.64	202.40	4857.60	103.22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	285.00	4.94	0.00	0.00	20.90	19.00	456.00	9.69
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 1								*Emissions (lb/year) Alternative 2*							
CO	*NOx*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*
3.2	**0.1**	**0.0**	**0.0**	**0.2**	**0.2**	**5.1**	**0.1**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.06	0.00	0.00	0.00	0.32	0.34	9.60	0.14
0.8	0.0	0.0	0.0	0.2	0.2	7.1	0.1	1557.14	0.00	0.00	0.00	470.08	499.46	14102.40	205.66
0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0	161.12	0.00	0.00	0.00	48.64	51.68	1459.20	21.28
0.7	0.0	0.0	0.0	0.2	0.2	6.6	0.1	1456.44	0.00	0.00	0.00	439.68	467.16	13190.40	192.36
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	101.76	0.00	0.00	0.00	30.72	32.64	921.60	13.44
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.6	**0.0**	**0.0**	**0.0**	**0.5**	**0.5**	**14.8**	**0.2**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.5	0.0	0.0	0.0	15.3	11.8	0.3	0.0	909.58	2.86	22.48	3.27	30660.00	23506.00	521.22	16.35
0.1	0.0	0.0	0.0	5.0	3.8	0.1	0.0	295.48	0.93	7.30	1.06	9960.00	7636.00	169.32	5.31
0.5	0.0	0.0	0.0	15.9	12.2	0.3	0.0	943.40	2.97	23.32	3.39	31800.00	24380.00	540.60	16.96
0.0	0.0	0.0	0.0	0.5	0.3	0.0	0.0	26.70	0.08	0.66	0.10	900.00	690.00	15.30	0.48
0.0	0.0	0.0	0.0	0.8	0.6	0.0	0.0	47.17	0.15	1.17	0.17	1590.00	1219.00	27.03	0.85
0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0	21.36	0.07	0.53	0.08	720.00	552.00	12.24	0.38
1.1	**0.0**	**0.0**	**0.0**	**37.8**	**29.0**	**0.6**	**0.0**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.03	0.07	0.05	0.01	0.00
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 1								*Emissions (lb/year) Alternative 2*							
CO	*NOx*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.44	0.12	0.01	0.00	4.80	4.80	5.60	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.53	0.15	0.02	0.00	5.76	5.76	6.72	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.53	0.15	0.02	0.00	5.76	5.76	6.72	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.09	0.02	0.00	0.00	0.96	0.96	1.12	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.31	0.09	0.01	0.00	3.36	3.36	3.92	0.00
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**								

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Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 2							
CO	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.1	0.0	0.0	0.0	0.1	0.1	2.5	0.0
0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0
0.9	0.0	0.0	0.0	0.1	0.0	1.1	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
3.6	**0.1**	**0.0**	**0.0**	**0.2**	**0.2**	**4.2**	**0.0**
0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0

Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 2							
CO	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
2.7	0.0	0.0	0.0	0.1	0.1	1.4	0.0
1.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
2.6	0.0	0.0	0.0	0.1	0.1	1.3	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.0	**0.1**	**0.0**	**0.0**	**0.3**	**0.1**	**3.5**	**0.0**
0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.0
38.0	0.7	0.0	0.0	1.5	0.8	19.2	0.0
14.3	0.3	0.0	0.0	0.6	0.3	7.2	0.0
26.4	0.5	0.0	0.0	1.0	0.5	13.4	0.0
2.6	0.0	0.0	0.0	0.1	0.1	1.3	0.0
2.4	0.0	0.0	0.0	0.1	0.0	1.2	0.0
0.9	0.0	0.0	0.0	0.0	0.0	0.5	0.0
85.0	**1.5**	**0.0**	**0.0**	**3.3**	**1.7**	**43.0**	**0.0**
0.1	0.0	0.0	0.0	0.1	0.1	1.1	0.0
0.3	0.0	0.0	0.0	0.5	0.3	3.9	0.0
0.1	0.0	0.0	0.0	0.2	0.1	1.3	0.0
0.4	0.1	0.0	0.0	0.7	0.4	6.0	0.0
0.1	0.0	0.0	0.0	0.2	0.1	1.6	0.0

Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 2							
CO	***NO$_x$***	***VOC***	***SO$_x$***	***PM$_{10}$***	***PM$_{2.5}$***	***CO^2***	***Pb***
0.1	0.0	0.0	0.0	0.2	0.1	1.8	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1.1	**0.2**	**0.0**	**0.0**	**1.9**	**1.1**	**15.8**	**0.0**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.5	0.0	0.0	0.0	0.1	0.1	2.3	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
1.5	0.0	0.0	0.0	0.1	0.1	2.4	0.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 2							
CO	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*
3.2	**0.1**	**0.0**	**0.0**	**0.2**	**0.2**	**5.1**	**0.1**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.8	0.0	0.0	0.0	0.2	0.2	7.1	0.1
0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0
0.7	0.0	0.0	0.0	0.2	0.2	6.6	0.1
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.6	**0.0**	**0.0**	**0.0**	**0.5**	**0.5**	**14.8**	**0.2**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.5	0.0	0.0	0.0	15.3	11.8	0.3	0.0
0.1	0.0	0.0	0.0	5.0	3.8	0.1	0.0
0.5	0.0	0.0	0.0	15.9	12.2	0.3	0.0
0.0	0.0	0.0	0.0	0.5	0.3	0.0	0.0
0.0	0.0	0.0	0.0	0.8	0.6	0.0	0.0
0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0
1.1	**0.0**	**0.0**	**0.0**	**37.8**	**29.0**	**0.6**	**0.0**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) *Alternative 2*							
CO	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tab H Table 1. Munition Emissions Estimates – Testing and Training – Offshore [1] (continued)

Emissions (TPY) Alternative 2							
CO	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Tab H Table 2. Munition Emissions Estimates – Testing and Training – Statewaters

Category	*Location – Range Complex*	*Number of Items (Annual) for Training & Testing Activities*	*Number of Items (Annual) for Training & Testing Activities*	*Emission Factors (lb/item)*								*Emissions (lb/year) Alternative 1*							
		Alternative 1	*Alternative 2*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO2*	*Pb*
Small Caliber	Northeast / NUWC Newport	8,320	8,320	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	14.98	0.23	0.00	0.00	0.82	0.73	17.47	0.10
	Virginia Capes/ Ches Bay + Trib	175,920	175,920	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	316.66	4.93	0.00	0.00	17.24	15.48	369.43	2.11
	Cherry Pt./Charleston	5,100	5,100	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	9.18	0.14	0.00	0.00	0.50	0.45	10.71	0.06
	Jacksonville/ C Canaveral	12,800	12,800	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	23.04	0.36	0.00	0.00	1.25	1.13	26.88	0.15
	Key West	0	0	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	0	0	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other AFTT	0	0	1.80E-03	2.80E-05	0.00E+00	0.00E+00	9.80E-05	8.80E-05	2.10E-03	1.20E-05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**202,140**	**202,140**																
Pyrotechnic Buoys (e.g. MK-58 Marine Marker)	Northeast / NUWC Newport	64	64	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	56.96	0.18	1.41	0.20	1920.00	1472.00	32.64	1.02
	Virginia Capes/ Ches Bay + Trib	978	978	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	870.42	2.74	21.52	3.13	29340.00	22494.00	498.78	15.65
	Cherry Pt./Charleston	0	0	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Jacksonville/ C Canaveral	64	64	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	56.96	0.18	1.41	0.20	1920.00	1472.00	32.64	1.02
	Key West	0	0	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	0	0	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other AFTT	0	0	0.8900	0.0028	0.0220	0.0032	30.0000	23.0000	0.5100	0.0160	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**1106**	**1106**																

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Tab H Table 2. Munition Emissions Estimates – Testing and Training – Statewaters (continued)

Category	Location – Range Complex	Number of Items (Annual) for Training & Testing Activities	Number of Items (Annual) for Training & Testing Activities	Emission Factors (lb/item)								Emissions (lb/year) Alternative 1							
		Alternative 1	Alternative 2	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO2	Pb	CO	NO_x	VOC	SO_x	PM_{10}	$PM_{2.5}$	CO2	Pb
Flares (Illumination)	Northeast / NUWC Newport	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Virginia Capes/ Ches Bay + Trib	20,400	20,400	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	224.40	63.24	6.73	1.49	2448.00	2448.00	2856.00	0.05
	Cherry Pt./Charleston	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Jacksonville/ C Canaveral	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Key West	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	GOMEX / NSWC Panama City	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other AFTT	0	0	0.0110	0.0031	0.0003	0.0001	0.1200	0.1200	0.1400	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Tab H Table 2. Munition Emissions Estimates – Testing and Training – Statewaters (continued)

Emissions (TPY) Alternative 1								Emissions (lb/year) Alternative 2							
CO	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO2*	*Pb*	*CO*	*NO_x*	*VOC*	*SO_x*	*PM_{10}*	*$PM_{2.5}$*	*CO^2*	*Pb*
0.0075	0.0001	0.0000	0.0000	0.0004	0.0004	0.0087	0.0000	14.98	0.23	0.00	0.00	0.82	0.73	17.47	0.10
0.1583	0.0025	0.0000	0.0000	0.0086	0.0077	0.1847	0.0011	316.66	4.93	0.00	0.00	17.24	15.48	369.43	2.11
0.0046	0.0001	0.0000	0.0000	0.0002	0.0002	0.0054	0.0000	9.18	0.14	0.00	0.00	0.50	0.45	10.71	0.06
0.0115	0.0002	0.0000	0.0000	0.0006	0.0006	0.0134	0.0001	23.04	0.36	0.00	0.00	1.25	1.13	26.88	0.15
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.2	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**								
0.0285	0.0001	0.0007	0.0001	0.9600	0.7360	0.0163	0.0005	56.96	0.18	1.41	0.20	1920.00	1472.00	32.64	1.02
0.4352	0.0014	0.0108	0.0016	14.6700	11.2470	0.2494	0.0078	870.42	2.74	21.52	3.13	29340.00	22494.00	498.78	15.65
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0285	0.0001	0.0007	0.0001	0.9600	0.7360	0.0163	0.0005	56.96	0.18	1.41	0.20	1920.00	1472.00	32.64	1.02
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.5	**0.0**	**0.0**	**0.0**	**16.6**	**12.7**	**0.3**	**0.0**								
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.1122	0.0316	0.0034	0.0007	1.2240	1.2240	1.4280	0.0000	224.4000	63.2400	6.7320	1.4892	2448.0000	2448.0000	2856.0000	0.0469
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	**0.0**	**0.0**	**0.0**	**1.2**	**1.2**	**1.4**	**0.0**								

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Tab H Table 2. Munition Emissions Estimates – Testing and Training – Statewaters (continued)

Emissions (TPY) Alternative 2							
CO	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.2	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**
0.0285	0.0001	0.0007	0.0001	0.9600	0.7360	0.0163	0.0005
0.4352	0.0014	0.0108	0.0016	14.6700	11.2470	0.2494	0.0078
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0285	0.0001	0.0007	0.0001	0.9600	0.7360	0.0163	0.0005
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.5	**0.0**	**0.0**	**0.0**	**16.6**	**12.7**	**0.3**	**0.0**
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.1122	0.0316	0.0034	0.0007	1.2240	1.2240	1.4280	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	**0.0**	**0.0**	**0.0**	**1.2**	**1.2**	**1.4**	**0.0**

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Tab H Table 3. Emission Totals by OPAREA

	Alternative 1								*Alternative 2*							
Location	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***	***CO***	***NO_x***	***VOC***	***SO_x***	***PM_{10}***	***$PM_{2.5}$***	***CO^2***	***Pb***
Northeast / NUWC Newport	0.7	0.0	0.0	0.0	1.1	0.8	1.5	0.0	0.7	0.0	0.0	0.0	1.1	0.8	1.5	0.0
Virginia Capes	49.2	0.9	0.0	0.0	33.7	25.8	38.4	0.2	49.2	0.9	0.0	0.0	33.7	25.8	38.4	0.2
Cherry Pt.	16.0	0.3	0.0	0.0	5.8	4.3	10.4	0.0	16.0	0.3	0.0	0.0	5.8	4.3	10.4	0.0
Jacksonville	34.8	0.6	0.0	0.0	19.1	14.3	31.0	0.2	34.8	0.6	0.0	0.0	19.1	14.3	31.0	0.2
Key West	2.9	0.1	0.0	0.0	0.8	0.5	3.0	0.0	2.9	0.1	0.0	0.0	0.8	0.5	3.0	0.0
GOMEX / Panama City	3.4	0.1	0.0	0.0	1.2	0.8	4.1	0.0	3.4	0.1	0.0	0.0	1.2	0.8	4.1	0.0
Other AFTT	1.4	0.0	0.0	0.0	0.4	0.3	0.6	0.0	1.4	0.0	0.0	0.0	0.4	0.3	0.6	0.0
Study Area Total	**108.4**	**2.0**	**0.0**	**0.0**	**62.1**	**46.8**	**89.1**	**0.4**	**108.4**	**2.0**	**0.0**	**0.0**	**62.1**	**46.8**	**89.1**	**0.4**

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Tab I: Ship and Boat Emission Factors

Tab I Table 1. Ship and Boat Emission Factors

Ship/Boat Type	Acronym	Emissions Factors (lb/hr) Propulsion Engines + Generators						Engine model[1]	#[1]	
		HC	CO	NO_x	SO_x	$PM_{10/2.5}$	CO^2		Engines	Use[1]
Nuclear Aircraft Carrier - Nimitz Class	CVN-1	0.31	1.23	16.73	1.39	0.12	683.62	16-645E5	4	Emergency Diesel Generator
	CVN-R	0.03	0.12	1.65	0.14	0.01	67.61			
Guided Missile Cruiser - Ticonderoga	CG-68	4.32	61.51	79.58	54.5	2.25	24,190.71	501-K17 LM2500	3 4	Ship Service Gas Turbine Generator Gas Turbines
	CG-R	2.46	27.73	285.54	109.99	10.04	69,838.52			
Guided Missile Destroyer - Arleigh Burk Class	DDG-51	4.01	59.72	114.52	62.15	2.96	27,564.55	501-K34	3	Ship Service Gas Turbine Generator
	DDG-51R	2.39	30.57	374.80	134.53	12.27	85141	LM2500	4	Gas Turbines
Guided Missile Destroyer - Zumwalt Class	DDG-1000	1.90	33.45	158.67	59.76	5.75	37,074.37	C-18 MT-5 MT-30	2 2 2	Emergency Diesel Generator Auxiliary Turbine Generator Main Turbine Generator
	DDG-1000R	2.86	45.65	64.80	29.91	4.05	24,051.17			
Littoral Combat Ship	LCS-1	3.19	46.14	186.77	49.63	6.67	25,512.41	16PA6B-STC MT-30 V1708	2 2 4	Main Propulsion Diesel Engine Main Turbine Generator Ship Service Diesel Generator
	LCS-1R	6.12	79.12	152.6	23.27	7.40	11,115.68			
Torpdeo Retrieval Boats Replaced by Dock Landing Ship	LSD 44	10.84	21.25	334.51	24.6	2.17	16,263.96	38D8-1/8 PC2.5V	4 4	Ship Service Diesel Generator Main Propulsion Diesel Engine
	LSD 44R	20.43	40.02	604.28	45.39	2.17	21,126.47			
Amphibious Assault Ship - America Class	LHA-6	14.48	8.38	277.87	66.87	8.38	35,922.07	12PA6B LM2500+	6 2	Ship Service Diesel Generator Main Turbine Generator
	LHA-6R	15.15	18.73	199.99	47.97	5.84	28,059.16			
Amphibious Assault Ship - Wasp	LHD-5	5.77	8.08	47.83	95.12	28.57	47,632.68	Boiler 16-251C	2	Emergency Diesel Generator
	LHD-5R	5.10	7.66	40.12	120.70	24.23	47,490.25			
Landing Transport Dock - San Antonio Class	LPD-19	16.86	31.61	272.28	37.54	3.29	16,767.15	3608 (Tier I) PC2.5STC	5 4	Ship Service Diesel Generator Main Propulsion Diesel Engine
	LPD-19R	14.95	28.08	263.75	32.98	2.81	15,025.58			
Patrol Coastal	PC-14	6.02	337.36	74.18	16.43	2.24	7,676.62	16RP200M 3306B	4 2	Main Propulsion Diesel Engine Ship Service Diesel Generator
	PC-14R	7.22	43.15	78.36	17.51	2.37	8,054.32			

Data Source: Navy and MSC Marine Engine Fuel Consumption and Emission Calculator

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Tab I Table 1. Ship and Boat Emission Factors (continued)

Ship/Boat Type	Acronym		Emissions Factors (lb/hr) Propulsion Engines + Generators					Engine model[1]	#[1]	
		HC	CO	NO_x	SO_x	$PM_{10/2.5}$	CO^2		Engines	Use[1]
Joint High Speed Vessel (JHSV) or Expeditionary Fast Transport (EPF)	JHSV-1	17.13	384.26	745.63	113.53	36.23	54,287.50	20V8000M71L 3406	4 4	Main Propulsion Diesel Engine Ship Service Diesel Generator
	JHSV-1R	4.65	100.83	200.57	30.32	9.80	14,530.65			
Amphibious Combat Command (LCC)	LCC 20	2.23	2.96	19.10	36.49	10.96	18,271.08	Boiler 38D8-1/8	2	Emergency Diesel Generator
	LCC 20R	2.19	2.96	17.38	36.40	10.95	18,217.39			
MV Deloros Chouest	MV DC	3.73	6.82	133.74	11.60	2.04	5,072.73	3306 3608TA	2 2	Ship Service Diesel Generator Main Propulsion Diesel Engine
	MV DCR	2.64	4.95	86.92	36.40	10.95	18,217.39			
SSGN	SSGN-728	0.07	0.11	4.05	0.23	0.02	132.35	38D8-1/8	1	Emergency Diesel Generator
	SSGN-728R	0.01	0.01	0.40	0.02	0.00	12.98			
SSN	SSN-774	0.05	0.12	0.91	0.17	0.03	81.42	3512B (Tier I)	1	Emergency Diesel Generator
	SSN-774R	0.00	0.01	0.09	0.02	0.00	8.00			
T-AH	AH-19	6.82	13.73	103.87	72.21	20.28	35,773.75	Boiler 12V 25/30 18V 20/27 3508	1 3 1	Ship Service Diesel Generator Auxiliary Diesel Generator Emergency Diesel Generator
	AH-19R	6.83	13.71	101.56	71.91	20.05	35,663.29			
TAKE	T-AKE-5	29.73	10.28	302.32	36.75	4.67	17,236.10	3516B HD 8L 48/60 9L 48/60	1 2 2	Emergency Diesel Generator IPG IPG
	T-AKE-5R	12.00	5.31	86.45	11.23	0.99	5,368.46			
TAO	T-AO-189	23.26	51.51	713.11	47.19	4.18	20,880.33	16V-92TA 8163- 7305 18-251F PC4.2V	1 2 2	Emergency Diesel Generator Ship Service Diesel Generator Main Propulsion Diesel Engine
	T-AO-189R	17.96	35.91	538.70	39.08	3.45	15,482.22			
TAOE	T-AOE-8	10.60	109.76	311.32	84.23	8.32	6,744.69	3608 LM2500	5 4	Ship Service Diesel Generator Main Propulsion Gas Turbine
	T-AOE-8R	5.85	35.08	445.24	134.08	12.22	81,478.38			
T-ARS	T-ARS-52	1.27	3.20	32.21	6.77	0.89	3,410.91	D399(M) D399(S)	4 3	Main Propulsion Diesel Engine Ship Service Diesel Generator
	T-ARS-52R	0.82	3.37	38.12	8.10	0.68	3,975.10			
T-ATF	T-ATF-172	2.11	18.41	104.32	7.82	0.91	3,594.48	16V-71T 7163- 7305 20-645E7	3 2	Ship Service Diesel Generator Main Propulsion Diesel Engine
	T-ATF-172R	2.59	13.35	139.75	10.24	1.07	4,845.75			

Data Source: Navy and MSC Marine Engine Fuel Consumption and Emission Calculator

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Tab I Table 1. Ship and Boat Emission Factors (continued)

Ship/Boat Type	Acronym	Emissions Factors (lb/hr) Propulsion Engines + Generators						Engine model[1]	Engines	Use[1]
		HC	CO	NO_x	SO_x	$PM_{10/2.5}$	CO^2			
Landing Craft Air Cushion	LCAC	0.35	1.23	2.93	0.38	0.25	668	T-62T-60-7	2	80 HP
								TF40B	4	3955 HP
Landing Craft Utility	LCU/LCM	0.52	36.21	44.95	3.11	1.57	1,683.91	2- Detroit 12V-71 Diesel engines, twin shaft, 680 hp sustained, used for both LCU and LCM data		
Amphibious Assault Vehicle	AAV-2	0.82	0.76	6.22	1.25	0.26		Detroit Diesel 8V-53T (P-7), Cummins VT 400 903 (P-7A1)		
Mark V	MK V	6.85	27.20	84.43	10.96	3.81	5,395	2x 2285 HP MTU 12V396 TE94 engines		
Rigid Inflatable Boat (zodiac)	RIB-4	0.06	0.34	9.14	1.44	0.15	1,163.88	Dual Caterpillar 3126 DITA, 6 in-line cylinder diesel, turbocharged, aftercooled.		470 HP x2
Combat Rubber Raiding Craft	CRRC	0.0128	0.2242	0.9538	0.0005	0.0289	87.23	55	HP 2-stroke engine	gas diesel EFs for small craft
High Speed Maneuverable Surface Target	HSMST	203.98	496.660	7.100	0.200	0.300	466.84	200	HP - 2 Mercury Optimax outboards	24.6 lb/hr fuel use jp-5
River Command Boat	RCB	1.12	2.81	27.40	4.08	0.66	1591	850	HP X 2	43.5 lb/hr fuel use diesel
River Assault Boat	RAB	0.58	1.46	14.18	2.11	0.34	838	440	HP X 2	22.9 lb/hr fuel use diesel
River Patrol Boat	RPB	0.58	1.46	14.18	2.11	0.34	838	440	HP X 2	22.9 lb/hr fuel use diesel
SEAARK	PB	0.56	1.39	13.54	2.02	0.33	739	420	HP X 2	20.2 lb/hr fuel use

F470 = CRRC

[1] Data from Navy and MSC Marine Engine Fuel Consumption & Emissions Calculator, US Navy, October 2016

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GPH =	specific fuel consumption constant X HP/ Fuel specific weight							
SFC diesel =		0.4						
SFC gas =		0.5						
FSW diesel =		7.2						
FSW gas =		6.1						
			0.138	MMBtu/gal diesel	161.5	lb/MMBTU	22.287	lb CO2/gal diesel
			0.125	MMBtu/gal motor gas	154.8	lb/MMBTU	19.35	lb CO2/gal motor gas
LCAC	889	GPH						
LCU	76	GPH						
MK V	254	GPH						
RIB	52	GPH						

EFs for small craft[2]			lb/hp-hr				
HP	HC	CO	NOx	SO2	PM	CO2	
50-100	0.000231938	0.004077	0.017342	9.86258E-06	0.000526	1.065422	0.953794
174-302	0.000231938	0.004077	0.017342	9.86258E-06	0.000526	1.065422	

[2] 2014 National Emissions Inventory, Version 1 Technical Support Document, USEPA. December 2016. Table 4-110.

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Tab J: Munition Emission Factors [1]

Tab J Table 1. Munitions Emission Factors

	Study Area		Emission Factor (lb/item)							
Type	*Category*	*DODEC ID*	*CO_2*	*CO*	*NO_x*	*VOC*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*Pb*
.50 CAL Blank	Small cal	A557	0.0021	0.0018	0.000028	0	0	0.000098	0.000088	0.000012
25 MM	medium cal	M793	0.043	0.085	0.0015	0	0	0.0033	0.0017	0.000049
81 MM HE Cartridge	large cal	C256	1.4	0.097	0.016	0	0	0.17	0.093	0.00069
2.75 In Rocket HE	rocket	H163	0.7	0.4	0.0056	0	0	0.24	0.12	0.0006
2.75 in Rocket (Practice)	rocket	H974	4.8	0.53	0	0	0	0.16	0.17	0.07
Floating Smoke Pot	for marine marker	K867	0.51	0.89	0.0028	0.022	0.0032	30	23	0.016
Grenade	grenade	G900	0.021	0.0008	0.00067	0.00000032	0.026	0.07	0.049	0.011
Flare	CM flare	L410	0.011	0.0013	0.00013	0.0004	0.0000079	0.0062	0.0062	0
Flare	Ill. Flare	L311	0.14	0.011	0.0031	0.00033	0.000073	0.12	0.12	0.0000023
2.75 In Rocket fleschette	rocket	H459	2.4	1.5	0.026	0	0	0.11	0.1	0.051

[1]Emission Factors from USEPA AP-42 Section 15 (various dates)

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Tab K: Aircraft Engine Emissions Factors and Profiles

Tab K Table 1. H-53 Emissions

Flight Operation	*Fuel used lb*	*Emissions in lbs/1000 lbs fuel*						*Total Pounds/op*					
		HC	*CO*	*NOx*	*SO_2*	*PM_{10}*	*CO_2*	*VOC*	*CO*	*NOx*	*SO_2*	*$PM_{10/2.5}$*	*CO_2*
LTO Total:	2,448.44				2.22			0.94	8.39	27.26	5.44	0.22	7,718
Cruise:													
Hourly	4,464	0.15	2.13	8.08	2.22	2.21	3,221	0.46	9.22	93.87		0.68	15,243

Tab K Table 2. H-60 Emissions

[1]Flight Operation	*[1]Total Number of Operations*	*Engine Power Setting*	*# Engines*	*Time in Mode (min)*	*Fuel Flow per engine lb/hr*	*Fuel used lb*	*Emissions in lbs/1000 lbs fuel*						*Total Pounds/op*					
							[2]HC	*[2]CO*	*[2]NOx*	*[4]SO2*	*[2]$PM_{10/2.5}$*	*[2]CO2*	*VOC*	*CO*	*NOx*	*SO2*	*$PM_{10/2.5}$*	*CO2e*
Departure:																		
APU Use		On	1	30	102	51	9.04	42.77	3.94	2.22	0.22	3,154.46	0.46	2.18	0.20	0.11	0.01	161
Start/Warm Up		15% Torque	2	10	274	91	0.77	18.65	4.6	2.22	4.20	3,182.96	0.07	1.70	0.42	0.20	0.38	291
Unstick		25% Torque	2	0.25	341	3	0.61	14.04	5.07	2.22	4.20	3,204.69	0.00	0.04	0.01	0.01	0.01	9
Taxi Out		20% Torque	2	5	308	51	0.66	16.01	4.85	2.22	4.20	3,196.08	0.03	0.82	0.25	0.11	0.22	164
Hover		80% Torque	2	2	707	47	0.55	4.61	6.9	2.22	4.20	3,220.14	0.03	0.22	0.33	0.10	0.20	152
Climbout		90% Torque	2	2	786	52	0.55	3.74	7.27	2.22	4.20	3,218.61	0.03	0.20	0.38	0.12	0.22	169
Total	1																	
Arrival:																		
APU Use		On	1	35	102	60	9.04	42.77	3.94	2.22	0.22	3154	0.54	2.54	0.23	0.13	0.01	188
Approach		50% Torque	2	5	501	84	0.55	8.34	5.93	2.22	4.20	3220	0.05	0.70	0.50	0.19	0.35	269
Unstick		25% Torque	2	0.25	341	3	0.61	14.04	5.07	2.22	4.20	3205	0.00	0.04	0.01	0.01	0.01	9
Taxi in/shut down		20% Torque	2	8	308	82	0.66	16.01	4.85	2.22	4.20	3196	0.05	1.31	0.40	0.18	0.34	263
Total	1																	
LTO Total:													**1.45**	**9.76**	**2.73**	**1.16**	**1.76**	**1,673**
Cruise:																		
Hourly	1	65% Torque	2	60	599.85	1199.7	0.55	6.25	6.40	2.22	4.20	3,221.36	**0.76**	**7.50**	**7.68**	**2.66**	**5.04**	**3,865**

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Tab K Table 3. E-2C Emissions

[1]Type of Operation	[1]Total Number of Operations	Engine Power Setting	No. of Engines in Use	Time in Mode/engine (min)	Fuel Flow per Engine (lb/hr)	Total Fuel Used (lb)	Emissions in lbs/1000 lbs fuel						Total Emissions in pounds/op					
							[2,3] HC	[2,3] CO	[2,3] NOx	[5] SO2	$PM_{10/2.5}$	[2,3] CO2	VOC	CO	NOx	SO2	$PM_{10/2.5}$	CO2e
Departure																		
Start/Warm up		L/S G Idle	2	12.0	599	240	22.32	30.11	3.53	2.22	3.97	3149.25	5.35	7.21	0.85	0.53	0.95	755
Taxi Out		H/S G Idle	2	5.0	756	126	1.42	5.65	6.35	2.22	3.97	3182.25	0.18	0.71	0.80	0.28	0.50	401
Engine Run-up		62% SHP	2	0.5	1,600	27	0.25	1.12	9.47	2.22	3.97	3225.67	0.01	0.03	0.25	0.06	0.11	86
Takeoff		Military	2	0.5	2,219	37	0.16	0.65	10.45	2.22	3.97	3229.32	0.01	0.02	0.39	0.08	0.15	119
Climbout		Military	2	2.0	2,219	148	0.16	0.65	10.45	2.22	3.97	3229.32	0.02	0.10	1.55	0.33	0.59	478
Total	1																	
Straight In Arrival																		
Approach		30% SHP	2	5.0	1100	183	0.49	2.16	8.06	2.22	3.97	3211.71	0.09	0.40	1.48	0.41	0.73	588.81
On runway		Flight Idle	2	1.0	836	28	1.10	4.54	6.52	2.22	3.97	3192.41	0.03	0.13	0.18	0.06	0.11	88.96
Taxi		H/S G Idle	1	3.0	756	38	1.42	5.65	6.35	2.22	3.97	3182.25	0.05	0.21	0.24	0.08	0.15	120.29
Shut down		L/S G Idle	1	1.0	599	10	22.32	30.11	3.53	2.22	3.97	3149.25	0.22	0.30	0.04	0.02	0.04	31.44
Total	1																	
LTO Total													**6.85**	**9.11**	**5.77**	**1.86**	**3.32**	**2,668**
Cruise																		
Hourly	1	30% SHP	2	60.0	1137	2,274	0.49	2.16	8.06	2.22	3.97	3211.71	**1.28**	**4.91**	**18.33**	**5.05**	**9.03**	**7,303**

Tab K Table 4. FA-18E/F and EA-18G Emissions

[1]Type of Operation	Total Number of Operations	[2,3] Engine Power Setting	[2,3] No. of Engines in Use	[2,3] Time in Mode/engine (min)	[2,3] Fuel Flow per Engine (lb/hr)	[2,3] Total Fuel Used (lb)	Emissions in lbs/1000 lbs fuel						Total Emissions in pounds/op					
							[2,3] HC	[2,3] CO	[2,3] NOx	[5] SO2	$PM_{10/2.5}$	[2,3] CO2	VOC	CO	NOx	SO2	$PM_{10/2.5}$	CO2e
Departure/Taxi out/Idle																		
APU Use	1	ON	1	5.0	197	16	0.25	2.00	6.25	2.22	0.22	3,170	0.00	0.03	0.10	0.04	0.00	52
Start/Warm-up	1	G Idle	2	15.0	695	348	65.33	98.18	3.18	2.22	12.64	2,973	22.70	34.12	1.11	0.77	4.39	1,033
Unstick	1	75% N2	2	0.3	1720	17	1.98	15.20	5.58	2.22	10.73	3,190	0.03	0.26	0.10	0.04	0.18	55
Taxi Out	1	G Idle	2	5.0	695	116	65.33	98.18	3.18	2.22	12.64	2,973	7.57	11.37	0.37	0.26	1.46	344
Engine Run-up	1	80% N2	2	0.5	3079	51	0.14	1.86	8.98	2.22	8.78	3,205	0.01	0.10	0.46	0.11	0.45	164
Takeoff	1	Max AB	2	0.5	35763	596	4.87	274.97	9.67	2.22	0.00	2,712	2.90	163.90	5.76	1.32	0.00	1,617
Climbout	1	95% N2	2	1.0	11320	377	0.12	0.70	36.29	2.22	2.95	3,179	0.05	0.26	13.69	0.84	1.11	1,200
Straight In Arrival																		
Approach	1	85% N2	2	3.0	5169	517	0.12	0.72	14.75	2.22	6.56	3,191	0.06	0.37	7.62	1.15	3.39	1,650
On Runway (WOW)	1	G Idle	2	1.0	695	23	65.33	98.18	3.18	2.22	12.64	2,973	1.51	2.27	0.07	0.05	0.29	69
Unstick	1	75% N2	2	0.3	1720	17	1.98	15.20	5.58	2.22	10.73	3,190	0.03	0.26	0.10	0.04	0.18	55
Taxi in/Shut Down	1	G Idle	2	8.0	695	185	65.33	98.18	3.18	2.22	12.64	2,973	12.11	18.20	0.59	0.41	2.34	551
LTO Total													**54.03**	**231.14**	**29.97**	**5.03**	**13.82**	**6,790**
Cruise																		
Hourly	1	85% N2	2	60	3318	6636	0.51	2.44	6.74	2.22	6.36	3,154	**3.89**	**16.19**	**44.73**	**14.73**	**42.20**	**20,930**

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Tab K Table 5. P-3 Emissions

[1]Type of Operation	Total Number of Operations	[2,3] Engine Power Setting	[2,3] No. of Engines in Use	[2,3] Time in Mode/engine (min)	[2,3] Fuel Flow per Engine (lb/hr)	[2,3] Total Fuel Used (lb)	Emissions in lbs/1000 lbs fuel						Total Emissions in lb/op					
							[2,3] HC	[2,3] CO	[2,3] NOx	[5] SO2	$PM_{10/2.5}$	[2,3] CO2	VOC	CO	NOx	SO2	$PM_{10/2.5}$	CO2e
Cruise																		
Hourly	1	37% shp	4	60	1200	4800	0.41	1.82	8.42	2.22	3.97	3216	**2.26**	**8.74**	**40.42**	**10.66**	**19.06**	**15,437**

Tab K Table 6. P-8 Emissions

[1]Type of Operation	Total Number of Operations	[2,3] Engine Power Setting	[2,3] No. of Engines in Use	[2,3] Time in Mode/engine (min)	[2,3] Fuel Flow per Engine (lb/hr)	[2,3] Total Fuel Used (lb)	Emissions in lbs/ lbs fuel						Total Emissions in lb/op					
							[2,3] HC	[2,3] CO	[2,3] NOx	[5] SO2	$PM_{10/2.5}$	[2,3] CO2	VOC	CO	NOx	SO2	$PM_{10/2.5}$	CO2e
Cruise																		
Hourly	1	30	4	60	2683	10732	0.000	0.003	0.022	0.002	ND	3.154	**2.47**	**34.34**	**231.81**	**23.83**	**ND**	**33,849**

Tab K Table 7. AV-8B Emissions

[1]Type of Operation		Total Number of Operations	[2] Engine Power Setting	[2] No. of Engines in Use	[2] Time in Mode/engine (min)	[2] Fuel Flow per Engine (lb/hr)	[2] Total Fuel Used (lb)	Emissions in lbs/1000 lbs fuel						Total Emissions in lb/op					
								[2] HC	[2] CO	[2] NOx	[4] SO2	$PM_{10/2.5}$	[3]CO2	VOC	CO	NOx	SO2	$PM_{10/2.5}$	CO2e
Short Takeoff																			
	APU Use	1	ON	1	5	197	16.4	0.25	2	6.25	2.22	0.22	3170	0.0	0.0	0.1	0.0	0.0	52
	Start/Warm-up	1	26% RPM	1	10	1137	189.5	19.66	106.3	1.8	2.22	11.1	2919	3.7	20.1	0.3	0.4	2.1	553
	Unstick	1	40% RPM	1	0.3	1786	8.9	3.67	65.7	2.5	2.22	9.1	3040	0.0	0.6	0.0	0.0	0.1	27
	Taxi Out	1	26% RPM	1	5	1137	94.8	19.66	106.3	1.8	2.22	11.1	2919	1.9	10.1	0.2	0.2	1.1	277
	Engine Run-up	1	59% RPM	1	0.5	3321	27.7	1.26	25.5	4.5	2.22	6.4	3114.5	0.0	0.7	0.1	0.1	0.2	86
	Takeoff	1	91% RPM	1	0.5	9441	78.7	0.35	3.6	12.7	2.22	2.5	3151.8	0.0	0.3	1.0	0.2	0.2	248
	Climbout	1	95% RPM	1	0.5	7037	58.6	0.49	6.4	9.5	2.22	3.5	3153.6	0.0	0.4	0.6	0.1	0.2	185
Vertical Landing Straight In															0.0				
	Approach	1	79% RPM	1	2.5	6381	265.9	0.54	7.7	8.6	2.22	3.8	3144	0.1	2.0	2.3	0.6	1.0	836
	Set up for VL	1	84% RPM	1	1.5	5785	144.6	0.61	9.3	7.8	2.22	4.2	3141.2	0.1	1.3	1.1	0.3	0.6	454
	VL Landing	1	99% RPM	1	0.75	12258	153.2	0.26	2.2	16.5	2.22	1.9	3155	0.0	0.3	2.5	0.3	0.3	483
	On Runway	1	26% RPM	1	0.3	1137	5.7	19.66	106.3	1.8	2.22	11.1	2919	0.1	0.6	0.0	0.0	0.1	17
	Unstick	1	40% RPM	1	0.3	1786	8.9	3.67	65.7	2.5	2.22	9.1	3040	0.0	0.6	0.0	0.0	0.1	27
	Taxi In/Shut down	1	26% RPM	1	5	1137	94.8	19.66	106.3	1.8	2.22	11.1	2919	1.9	10.1	0.2	0.2	1.1	277
	LTO Total													**9.2**	**47.2**	**8.5**	**2.5**	**6.9**	**3,522**
Cruise																			
	Hourly	1	67% RPM	1	60	4313	4313.0	0.88	16	5.9	2.22	5.3	3130	**4.4**	**69.0**	**25.4**	**9.6**	**22.9**	**13,499**

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Tab K Table 8. MV-22 Emissions

Flight Mode	*Fuel Used (lbs)*	*Emission Indices (lb per 1,000 lb fuel)*							*Total Emissions in lb/op*				
		HC	*CO*	*NOx*	*SO_2*	*$PM_{10/2.5}$*	*CO_2*	*VOC*	*CO*	*NOx*	*SO_2*	*$PM_{10/2.5}$*	*CO_2*
Short Take Off													
APU	103.3	0.19	5.89	5.95	2.22	0.22	3,235	0.02	0.61	0.61	0.23	0.02	334
Start/Warm up	60	0.1	8.9	4.09	2.22	1.58	3,221	0.01	0.53	0.25	0.13	0.09	193
Warm up	220	0.02	3.33	6.02	2.22	1.58	3,219	0.00	0.73	1.32	0.49	0.35	708
Taxi Out	110	0.02	3.33	6.02	2.22	1.58	3,219	0.00	0.37	0.66	0.24	0.17	354
Engine Run up	17.2	0.02	1.58	8.41	2.22	1.58	3,216	0.00	0.03	0.14	0.04	0.03	55
Takeoff	68.7	0.01	0.45	15.06	2.22	1.58	3,208	0.00	0.03	1.03	0.15	0.11	220
FW Climbout	54.7	0.01	0.69	12.35	2.22	1.58	3,211	0.00	0.04	0.68	0.12	0.09	176
Vertical Landing													
FW Approach	121.0	0.02	1.20	9.57	2.22	1.58	3,215	0.00	0.15	1.16	0.27	0.19	389
Transition (90°) Landing	43.7	0.02	1.04	10.22	2.22	1.58	3,214	0.00	0.05	0.45	0.10	0.07	140
Taxi to apron	66.0	0.02	3.33	6.02	2.22	1.58	3,219	0.00	0.22	0.40	0.15	0.10	212
Cool/Shut down	24.0	0.1	8.90	4.09	2.22	1.58	3,221	0.00	0.21	0.10	0.05	0.04	77
APU	34.4	0.19	5.89	5.95	2.22	0.22	3,235	0.01	0.20	0.20	0.08	0.01	111
LTO Total								**0.05**	**3.16**	**7.00**	**2.05**	**1.27**	**2,971**
Cruise													
Hourly	3,540	0.01	0.60	13.19	2.22	1.58	3210	**0.04**	**2.12**	**46.69**	**7.86**	**5.59**	**11,363**

Tab K Table 9. Learjet Emissions

Flight Mode	*Fuel Used (lbs)*	*Emission Indices (lb per 1,000 lb fuel)*						*Emissions from 1 Hour in Flight Mode in Pounds*					
		HC	*CO*	*NOx*	*SO_2*	*$PM_{10/2.5}$*	*CO_2*	*VOC*	*CO*	*NOx*	*SO_2*	*$PM_{10/2.5}$*	*CO_2*
Cruise - Hourly	1,476	0.07	1.62	16.08	2.22	0.085	3252.46	0.118818	2.39	23.73	3.28	0.13	4,801

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Tab K Table 9. F-35 Emissions

Mode/Starting Point for Leg		Time	Flight Emissions (lb/operation)					
	Power	(min)	HC	CO	NOx	SO_2	PM10/2.5	CO_2
IPP Use	Main Engine Start	0.58	< 0.000	0.00	0.01	0.00	0.00	4
Start/Warm Up	GI (10% ETR)	6.00	< 0.098	3.74	0.43	0.19	0.02	647
Unstick	35% ETR	0.08	< 0.000	0.01	0.10	0.01	0.00	32
Taxi	GI (10% ETR)	6.00	< 0.098	3.74	0.43	0.20	0.02	649
Unstick	35% ETR	0.08	< 0.000	0.01	0.10	0.01	0.00	32
Taxi to position & hold	GI (10% ETR)	0.50	< 0.008	0.31	0.04	0.02	0.00	54
P3-F-35B Short Takeoff (STO)	Departure	1	< 0.002	0.18	12.12	0.46	0.05	1,537
P25-F-35B STOVL Pattern Takeoff Portion (Austere Ops)	Pattern	1	< 0.000	0.06	3.56	0.14	0.02	471
P13-F-35B Overhead Break/Carrier Break Arrival to Vertical Landing (VL)	Arrival	1	< 0.014	0.68	14.07	0.84	0.08	2,803
Rollout to taxiway	FI (15% ETR)	0.55	< 0.005	0.10	0.16	0.03	0.00	100
Weapon check	GI (10% ETR)	3.00	< 0.049	1.87	0.21	0.10	0.01	323
Unstick	35% ETR	0.08	< 0.000	0.01	0.11	0.01	0.00	34
Taxi	GI (10% ETR)	3.00	< 0.048	1.82	0.22	0.10	0.01	326
Hot refuel	GI (10% ETR)	7.00	< 0.114	4.37	0.50	0.23	0.02	754
Unstick	35% ETR	0.08	< 0.000	0.01	0.11	0.01	0.00	34
Taxi to park & shutdown	GI (10% ETR)	0.60	< 0.010	0.36	0.04	0.02	0.00	65
Total for 1 LTO	**1**		**< 0.513**	**17.29**	**32.20**	**2.37**	**0.22**	**7,866**
	Fuel Use							
*Cruise - 1 hour	60860.90	60	12.60	979.86	448.54	124.16	69.99	188,608

*from Lemoore Op AQ Calcs May 2014 in Final Environmental Impact Statement US Navy F-35C West Coast Homebasing, Vol II, Appendix D.

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Tab K Table 10. UH-1 Emissions

Flight Operation	Fuel used lb	Emissions in lbs/1000 lbs fuel							Flight Emissions (lb/operation)					
		HC	CO	NOx	SO_2	PM_{10}	$PM_{2.5}$	CO_2	VOC	CO	NOx	SO_2	$PM_{10/2.5}$	CO2
Departure:														
Warm Up	74.0	6.21	28.36	3.13	2.22	4.20	4.20	3,145	0.46	2.10	0.23	0.16	0.31	233
Taxi Out	33.8	0.13	1.11	5.67	2.22	4.20	4.20	3,207	0.00	0.04	0.19	0.08	0.14	108
Hover	23.1	0.13	1.01	5.79	2.22	4.20	4.20	3,207	0.00	0.02	0.13	0.05	0.10	74
Climbout	36.3	0.13	0.88	6.02	2.22	4.20	4.20	3,207	0.00	0.03	0.22	0.08	0.15	116
Arrival:														
Descent	24.1	0.28	5.76	4.3	2.22	4.20	4.20	3,202	0.01	0.14	0.10	0.05	0.10	77
Approach	25.8	0.20	4.22	4.54	2.22	4.20	4.20	3,204	0.01	0.11	0.12	0.06	0.11	83
Taxi to Sdrn	22.5	0.13	1.11	5.67	2.22	4.20	4.20	3,207	0.00	0.02	0.13	0.05	0.09	72
Shut Down	4.9	6.21	28.36	3.13	2.22	4.20	4.20	3,145	0.03	0.14	0.02	0.01	0.02	16
								Total in Pounds	0.59	2.60	1.14	0.54	1.03	779
1- hr Cruise:	692	0.13	1.01	5.79	2.22	4.20	4.20	3,207	0.10	0.70	4.01	1.54	2.91	2,221

Tab K Table 11. AH-1 Emissions

Flight Operation	Fuel used lb	Emissions in lbs/1000 lbs fuel							Flight Emissions (lb/operation)					
		HC	CO	NOx	SO_2	PM_{10}	$PM_{2.5}$	CO_2	VOC	CO	NOx	SO_2	$PM_{10/2.5}$	CO2
Departure:														
Warm Up	79.5	0.98	22.49	4.29	2.22	4.20	4.20	3,162	0.08	1.79	0.34	0.18	0.33	251
Taxi Out	39.32	0.57	11.7	5.37	2.22	4.20	4.20	3,213	0.02	0.46	0.21	0.09	0.17	126
Hover	13.11	0.57	11.7	5.37	2.22	4.20	4.20	3,213	0.01	0.15	0.07	0.03	0.06	42
Climbout	29.19	0.56	10.13	5.61	2.22	4.20	4.20	3,217	0.02	0.30	0.16	0.06	0.12	94
Arrival:														
Approach	113.8	0.61	14.04	5.07	2.22	4.20	4.20	3,205	0.07	1.60	0.58	0.25	0.48	365
Taxi to Sdrn	39.3	0.57	11.7	5.37	2.22	4.20	4.20	3,213	0.02	0.46	0.21	0.09	0.17	126
Shut Down	10.9	2.54	39.81	3.28	2.22	4.20	4.20	3,060	0.03	0.44	0.04	0.02	0.05	33
								Total in Pounds	0.28	5.19	1.61	0.72	1.37	1,038
1- hr Cruise:	850	0.56	10.54	5.55	2.22	4.20	4.20	3,216	0.55	8.96	4.72	1.89	3.57	2,734

[1] for information on aircraft references, see Tab O, Aircraft Engine Emission Factor Sources

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Tab L: Aircraft Activity – Testing

Tab L Table 1. Aircraft Activity – Testing

H-60	*# a/c*	*Hr/event*	*Alternative 1 Total Hrs*													*Panama City*
			# Events	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*	
Anti-Submarine Warfare Torpedo Test	1	30		0	29	870	72	2,160	0	0	0	0	0	0	0	0
Anti-Submarine Warfare Tracking Test – Helicopter	1	30	5	150	6	180	190	5,700	8	240	61	1,830	0	0	0	0
Kilo Dip	1	1	3	3	3	3	30	30	3	3	2	2	0	0	0	0
Chaff Test	3	30	20	1,800	4	360	24	2,160	0	0	0	0	0	0	0	0
Flare Test	1	30	10	300	0	0	20	600	0	0	0	0	0	0	0	0
Airborne Dipping Sonar Minehunting Test	1	30	0	0	0	0	8	240	0	0	0	0	0	0	19	570
Airborne Laser Based Mine Detection System Test	1	2	0	0	0	0	50	100	0	0	0	0	0	0	40	80
Airborne Mine Neutralization System Test	1	2	0	0	0	0	29	58	0	0	0	0	0	0	21	42
Airborne Sonobuoy Minehunting Test	1	30	0	0	0	0	24	720	0	0	0	0	0	0	52	1,560
Air-to-Surface Gunnery Test	1	2	0	0	43	86	128	256	0	0	0	0	0	0	0	0
Air-to-Surface Missile Test	1	3	5	15	33	99	133	399	0	0	0	0	0	0	0	0
High-Energy Laser Weapons Test	1	2	0	0	0	0	108	216	0	0	0	0	0	0	0	0
Laser Targeting Test	3	0.5	0	0	0	0	8	12	0	0	0	0	0	0	0	0
Rocket Test	1	3	0	0	51	153	33	99	0	0	0	0	0	0	0	0
Maritime Security	1	4	0	0	12	48	20	80	0	0	0	0	12	48	0	0
	Alternative 1 Totals			**2,268**		**1,799**		**12,830**		**243**		**1,832**		**48**		**2,252**

[1] Provided by US Navy, NAVAIR Assumptions.docx, March 30, 2017.

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Tab L Table 1. Aircraft Activity – Testing (continued)

	Alternative 2 Total Hrs												
# Events	***GOMEX***	***# Events***	***JAX***	***# Events***	***VACAPES***	***# Events***	***KW***	***# Events***	***NE***	***# Events***	***CHERRY PT***	***# Events***	***Panama City***
0	0	43	1,290	121	3,630	0	0	0	0	0	0	0	0
6	180	12	360	280	8,400	27	810	110	3,300	0	0	0	0
6	6	6	6	40	40	6	6	4	4	0	0	0	0
20	1,800	4	360	24	2,160	0	0	0	0	0	0	0	0
10	300	0	0	20	600	0	0	0	0	0	0	0	0
0	0	0	0	18	540	0	0	0	0	0	0	32	960
0	0	0	0	50	100	0	0	0	0	0	0	40	80
0	0	0	0	50	100	0	0	0	0	0	0	32	64
0	0	0	0	24	720	0	0	0	0	0	0	52	1,560
0	0	55	110	280	560	0	0	0	0	0	0	0	0
10	30	38	114	444	1,332	0	0	0	0	0	0	0	0
0	0	0	0	108	216	0	0	0	0	0	0	0	0
0	0	0	0	8	12	0	0	0	0	0	0	0	0
0	0	57	171	35	105	0	0	0	0	0	0	0	0
0	0	12	48	20	80	0	0	0	0	12	48	0	0
Alternative 2 Totals	**2,316**		**2,459**		**18,595**		**816**		**3,304**		**48**		**2,664**

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Tab M: Aircraft Activity – Training[1]

Tab M Table 1. Aircraft Activity – Training[1] (5 Years Presented Annually)

UH-1			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Missile Exercise Air-to-Air	15	1	0	0	2	24	8	120	2	24	0	0	2	24	0
Missile Exercise Surface-to-Air	15	1	0	0	0	0	0.4	6	0	0	0	0	0	0	0
Antitsubmarine Warfare Torpedo Exercise - Ship	8	2	0	0	3	51	8	128	0	0	0	0	0	0	0
Antisubmarine Warfare Torpedo Exercise - Submarine	6	3	0	0	2	43	8	144	0	0	1	22	0	0	0
Gunnery Exercise Air-to-Surface Small Caliber	1	1	0	0	0	0	0	0	0	0	0	0	3	3	0
	Alternative Totals			**0**		**118**		**398**		**24**		**22**		**27**	

Learjet			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Gunnery Exercise Surface-to-Air Medium Caliber	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0
Gunnery Exercise Surface-to-Air Large Caliber	1	1	0	0	0	0	5	5	0	0	0	0	0	0	0
Gunnery Exercise Surface-to-Air Medium Caliber	1	1	0	0	0	0	7	7	0	0	0	0	0	0	0
	Alternative Totals			**0**		**0**		**13**		**0**		**0**		**0**	

H-60			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Gunnery Exercise Air-to-Surface Small Caliber	1	1	0	0	40	40	112	112	0	0	0	0	24	24	0
Missile Exercise Air-to-Surface - Rocket	1	1	2	2	20	20	20	20	0	0	0	0		0	0
Missile Exercise Air-to-Surface	1	1	0	0	18	18	14	14	0	0	0	0	3	3	0
Laser Targeting - Aircraft	1	1	0	0	55	55	27	27	0	0	0	0		0	0
Antisubmarine Warfare Tracking Exercise - Helicopter	1	3	1	2	74	222	2	5	0	0	0	0	2	7	0
Antisubmarine Warfare Torpedo Exercise - Helicopter	1	3	0	0	3	8	1	2	0	0	0	0	0	0	0
Antisubmarine Warfare Torpedo Exercise - Submarine	3	3	0	0	0	0	0	0	0	0	1	11	0	0	0
Airborne Mine Countermeasures - Mine Detection	1	2	62	124	63	127	308	616	0	0	0	0	74	148	0
Mine Countermeasure Mine Neutralization Remotely Operated Vehicle	1	2	26	53	14	28	126	252	0	0	0	0	14	28	0
Search and Rescue	1	1	0	0	125	125	200	200	0	0	0	0	0	0	0
Personnel Insertion/Extraction - Air	1	2	10	20	2	4	36	71	0	0	0	0	0	0	0
PMINT	1	63.8	0	0	0	0	0	0	0	0	0	0	1	64	0
ARGMEUEX	1	149.3	0	0	0	0	0	0	0	0	0	0	1	149	0
CERTEX	1	139.4	0	0	0	0	0	0	0	0	0	0	1	139	0
	Alternative Totals			**201**		**648**		**1,319**		**0**		**11**		**564**	

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H-53			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Airborne Mine Countermeasures - Towed Mine Neutralization	1	2	0	0	31	62	176	352	0	0	0	0	37	73	0
Airborne Mine Countermeasures - Mine Detection	1	2	0	0	63	127	308	616	0	0	0	0	74	148	0
Mine Countermeasure Mine Neutralization Remotely Operated Vehicle	1	2	0	0	14	28	126	252	0	0	0	0	14	28	0
Search and Rescue	1	1	0	0	125	125	200	200	0	0	0	0		0	0
		Alternative Totals		**0**		**342**		**1,420**		**0**		**0**		**250**	

F-18 E/F			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Gunnery Exercise Air-to-Surface Medium Caliber	2.5	0.33	6	5	49	40	44	36	0	0	0	0	29	24	0
Mine Laying	2.5	0.33	0	0	0.2	0.2	1	1	0	0	0	0	0.4	0.3	0
		Alternative Totals		**5**		**41**		**37**		**0**		**0**		**24**	

F-35			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Gunnery Exercise Air-to-Surface Medium Caliber	2.5	0.33	6	5	49	40	44	36	0	0	0	0	29	24	0
Mine Laying	2.5	0.33	0	0	0.2	0.2	1	1	0	0	0	0	0.4	0.3	0
		Alternative Totals		**5**		**41**		**37**		**0**		**0**		**24**	

P-3			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	2.5	1	0	0	18	46	6	15	0	0	3	8	2	4	0
Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	2.5	1	0	0	3	7	0	0	0	0	0	0	0	0	0
		Alternative Totals		**0**		**53**		**15**		**0**		**8**		**4**	

P-8			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Antisubmarine Warfare Tracking Exercise - Maritime Patrol Aircraft	2.5	1	0	0	74	184	25	62	0	0	13	32	6	16	0
Antisubmarine Warfare Torpedo Exercise - Maritime Patrol Aircraft	2.5	1	0	0	0	0	1	2	0	0	0	0	0	0	0
Antisubmarine Warfare Torpedo Exercise - Submarine	3	3	0	0	0	0	0	0	0		1	11	0	0	0
Mine Laying	2.5	0.33	0	0	0	0.2	1	1	0	0	0	0	0.4	0.3	0
		Alternative Totals		**0**		**185**		**64**		**0**		**42**		**16**	

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AV-8B			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Gunnery Exercise Air-to-Surface Medium Caliber	2.5	0.33	0	0	5	4	0	0	0	0	0	0	4	3	0
		Alternative Totals		**0**		**4**		**0**		**0**		**0**		**3**	

AH-1			*Alternative Total Hrs*												
	# a/c	*Hr/event*	*# Events*	*GOMEX*	*# Events*	*JAX*	*# Events*	*VACAPES*	*# Events*	*KW*	*# Events*	*NE*	*# Events*	*CHERRY PT*	*# Events*
Gunnery Exercise Air-to-Surface Small Caliber	1	1	0	0	0	0	0	0	0	0	0	0	2	2	0
Missile Exercise Air-to-Surface - Rocket	1	1	0	0	2	2	0	0	0	0	0	0	2	2	0
Missile Exercise Air-to-Surface	1	1	0	0	0	0	0	0	0	0	0	0	3	3	0
		Alternative Totals		**0**		**2**		**0**		**0**		**0**		**5**	

[1] Provided by US Navy, AFTT Training Air Analysis.xlsx, March 30 2017; IKE C2X.xlsx, March 29 2017; C2X Sorties hours.xlsx, March 13 2017; Marine Corps training cycle.xlsx, March 29 2017.

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Tab N: Aircarft Activity By Region[1]

Tab N Table 1. VACAPES Annual Hours Flight Below 3,000 Ft.

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
398	13	14,149	19,914	1,420	37	37	15	64	0	0	0	0

Tab N Table 2. VACAPES LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	64	0	0	58	58	0	0	0	0	0	0

Tab N Table 3. VACAPES Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	2,489	0	392	0	0	0	0	0	0	0	0

Tab N Table 4. GOMEX Annual Hours Flight Below 3,000 Ft.

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	2,469	2,517	0	5	5	0	0	0	0	0	0

Tab N Table 5. GOMEX LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	0	0	0	0	0	0	0	0	0	0	0

Tab N Table 6. GOMEX Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	20	0	0	0	0	0	0	0	0	0	0

Tab N Table 7. JAX Annual Hours Flight Below 3,000 Ft.

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
118	0	2,447	3,107	342	41	41	53	185	0	4	2	0

Tab N Table 8. JAX LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	129	0	0	491	491	0	0	0	0	0	0

Tab N Table 9. JAX Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	159	0	0	0	0	0	0	0	0	0	0

Tab N Table 10. KW Annual Hours Flight Below 3,000 Ft

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
24	0	243	816	0	0	0	0	0	0	0	0	0

Tab N Table 11. KW LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	0	0	0	0	0	0	0	0	0	0	0

Tab N Table 12. KW Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	0	0	0	0	0	0	0	0	0	0	0

Tab N Table 13. NE Annual Hours Flight Below 3,000 Ft.

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	1,843	3,315	0	0	0	8	42	0	0	0	0

Tab N Table 14. NE LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	0	0	0	0	0	0	0	0	0	0	0

Tab N Table 15. NE Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	0	0	0	0	0	0	0	0	0	0	0

Tab N Table 16. CHERRY PT Annual Hours Flight Below 3,000 Ft.

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
27	0	612	612	250	24	24	4	16	0	3	5	0

Tab N Table 17. CHERRY PT LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	233.5	0	0	157	157	0	0	0	107	0	110

Tab N Table 18. CHERRY PT Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	2.4	0	0	0	0	0	0	0	0	22	0

Tab N Table 19. OTHER Annual Hours Flight Below 3,000 Ft.

UH-1	Learjet	Alt 1 H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	2,252	2,664	0	0	0	0	0	0	0	0	0

Tab N Table 20. OTHER LTOs

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	0	0	0	0	0	0	0	0	0	0	0

Tab N Table 21. OTHER Annual Hours Flight Below 3,000 Ft - State Waters

UH-1	Learjet	H-60	Alt 2 H-60	H-53	F-18	F-35	P-3	P-8	E-2C	AV-8B	AH-1	MV-22
0	0	2,252	2,664	0	0	0	0	0	0	0	0	0

[1] Provided by US Navy, *AFTT Training Air Analysis.xlsx*, March 30 2017; *IKE C2X.xlsx*, March 29 2017; *C2X Sorties hours*.xlsx, March 13 2017; *Marine Corps training cycle.xlsx*, March 29 2017, *NAVAIR Assumptions.docx*, March 30 2017.

Tab O: Aircraft Engine Emission Factor Sources

Tab O Table1. Cruise based on 1 hour

Aircraft	Source of Emissions Indices
AH-1W	AESO Memorandum Report No. 9824, Revision C, November 2015.
AV-8B – LTO	AESO Memorandum Report No. 9913, Revision D, November 2009.
AV-8B – Cruise	AESO Memorandum Report No. 9963, Revision C, November 2009.
CH-53 – LTO CH-53 - cruise	AESO Memorandum Report No. 2015-01 Revision B,September 2015.
E-2 / E-2C – Cruise	AESO Memorandum Report No. 9920, Revision E. September 2015.
P-8 – Cruise	Engine Datasheet 8CM051, ICAO Engine Exhaust Emissions Data Bank (ICAO, 2007)
F-35B – LTO	JSF Emissions Package_2011-12-28.xls from Flint Webb, 2013.
F-35B Cruise	From "Demonstration Sortie Cruise" from F-35 West-Coast Basing EIS, 2014
FA-18E/F & EA-18G – LTO	AESO Memorandum Report No. 9815, Revision H. November 2015
FA-18E/F & EA-18G Cruise	AESO Memorandum Report No. 9933, Revision E, November 2015
Learjet	USAF Institute for Environment, Safety and Occupational Health Risk Analysis, October 2002.
HH-60 - LTO & Cruise	AESO Memorandum Report No. 9929 Revision C. January 2016
P-3	AESO Memorandum Report No. 9911, Revision C, Feb 2010.
V-22 – LTO V-22 - Cruise	AESO Memorandum Report No. 9946, Revision G, April 2016
UH-1N – LTO	AESO Memorandum Report No. 9904, Revision A, May 1999
UH-1N – Cruise	AESO Memorandum Report No. 9962, Rev A November 2009

PM2.5 = PM10 emissions, in accordance with AESO Memorandum Report No. 2013-04 Revision A, January 2014. PM2.5 to PM10 Ratio for Aircraft Emitted Particles.

AESO Report 2012-01D, December 2014. Sulfur Dioxide Emission Index Using JP-5 and JP-8 Fuel.

VOC correction from US Environmental Protection Agency, Recommended Best Practice for Quantifying Speciated Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet and Turboprop Engines - Vresion 1.0, Report No. EPA-420-R-09-901, May 2009.

Tab P: Munition Activity Data[1]

Tab P Table 1. Inshore Munitions - Alternatives 1 and 2 - State Waters

	Munitions/Materials		
	Projectiles		*Counter measure*
	Small Caliber (Non-explosive)	*Marine Marker*	*Flare*
Location	*Number*	*Number*	*Number*
Boston, MA	0	0	0
Narragansett Bay, RI	8,320	64	0
Earle, NJ	0	0	0
Delaware Bay, DE	0	0	0
Wilmington, DE	0	0	0
Hampton Roads, VA	0	0	0
James River and Tributaries, VA	97,920	728	20,400
York River, VA	0	20	0
Lower Chesapeake Bay	78,000	230	0
Morehead City, NC	0	0	0
Cooper River, SC	5,100	0	0
Savannah, GA	0	0	0
Kings Bay, GA	0	0	0
Mayport, FL	0	0	0
Port Canaveral, FL	12,800	64	0
Tampa, FL	0	0	0
Beaumont, TX	0	0	0
Corpus Christi, TX	0	0	0

Tab P Table 2. Munitions for Use During Training in a Single Year under Alternatives 1 and 2 - Beyond State Waters

Munitions/Materials	*Range Complex*							
	Northeast Number	*VACAPES Number*	*Cherry Point Number*	*JAX Number*	*Key West Number*	*GOMEX Number*	*Other RC Number*	*SINKEX Area Number*
Bombs								
Bombs (Explosive)	0	88	0	56	0	4	0	12
Projectiles								
Small-Caliber (Non-Explosive)	27,000	2,262,000	393,000	1,026,000	0	83,000	100,000	0
Small-Caliber (Casing Only)	0	5,000	0	5,000	0	0	0	0
Medium-Caliber (Explosive)	0	46,100	20,000	45,600	0	6,000	0	0
Medium Caliber (Non-Explosive)	1,000	658,561	328,149	383,861	28,000	28,950	21,150	0
Large-Caliber (Explosive)	0	762	210	642	0	114	114	200
Large-Caliber (Non-Explosive)	0	4,930	1,234	2,534	0	498	210	0
Large-Caliber (Casing only)	0	0	1,040	0	0	0	0	0
Missiles								
Missiles (Explosive)	2	199	187	192	8	2	0	4
Rockets (Explosive)	0	1,748	76	1,824	0	190	0	0
Rockets (Non-Explosive)	1	1,835	304	2,095	0	191	0	0
Rockets (Non-Explosive): Flechette	0	95	0	110	0	0	0	0
Countermeasures								
Flares	0	1,040	22,348	38,048	31,008	1,840	0	0
Other								
Grenades (Explosive)	56	4070	28	28	0	28	0	0
Illumination Flare	0	40	48	48	8	0	0	0
Marine Marker	0	1,022	332	1,060	30	53	24	0
Total	***37,882***	***4,709,821***	***1,361,843***	***2,194,749***	***276,062***	***285,861***	***222,916***	***219***

Tab P Table 3. Munitions for Use During Testing in a Single Year under Alternatives 1 and 2 - Beyond State Waters

	Range Complex						*Testing Ranges*		
Munitions/Materials	***Northeast Number***	***VACAPES Number***	***Cherry Point Number***	***JAX Number***	***Key West Number***	***GOMEX Number***	***NUWC Newport Number***	***SFOMF Number***	***NSWC Panama City Number***
Bombs									
Bombs (Explosive)	0	4	0	0	0	0	0	0	0
Projectiles									
Small-Caliber (Non-Explosive)	4,800	77,800	4,800	4,800	4,800	17,800	0	0	7,000
Medium-Caliber (Explosive)	3,860	17,270	3,360	14,860	3,360	3,360	0	0	0
Medium Caliber (Non-Explosive)	9,060	234,665	8,160	237,360	32,660	22,860	0	0	5,100
Large-Caliber (Explosive)	1632	4,763	1632	7,876	2332	2243	0	4	280
Large-Caliber (Non-Explosive)	1,761	8,147	1,440	14,524	3,190	2,774	0	0	280
Missiles									
Missiles (Explosive)	10	222	0	70	0	12	0	0	0
Missiles (Non-Explosive)	25	1633	25	594	32	42	0	0	0
Rockets (Explosive)	0	206	0	200	0	0	0	0	0
Rockets (Non-Explosive)	1	759	0	407	0	1	0	0	0
Rockets (Non-Explosive): Flechette	0	249	0	136	0	0	0	0	0
Countermeasures									
Flares	0	20,195	0	0	0	600	0	0	0

[1] Munitions Usage Estimates provided by US Navy, AFTT Training Air Analysis.xlsx (March 29), AFTT Inshore Events_08Feb2017_NAEMO Web.xlsx, Appendix F, Draft AFTT EIS May 2017.

Tab Q: Baseline (V2 Preferred Alternative) Munition Summary[1]

Tab Q Table 1. Baseline (V2 Preferred Alternative) Munition Summary

		CO	NOx	VOC	SOx	PM10	PM2.5
TOTALS BY COMPLEX for TRAINING AND TESTING COMBINED (TPY)	Northeast / NUWC Newport	0.0685	0.0018	0.0000	0.0000	0.0344	0.0063
	Virginia Capes	26.8013	1.1019	0.0000	0.0000	1.9281	1.2623
	Navy Cherry Pt.	5.5601	0.1465	0.0000	0.0000	0.1426	0.0755
	Jacksonville	14.1096	0.5870	0.0000	0.0001	1.4573	0.8805
	Key West	1.0447	0.0405	0.0000	0.0000	0.0221	0.0155
	GOMEX / Panama City	1.9943	0.0437	0.0000	0.0000	0.1222	0.0739
	Other AFTT	0.8713	0.0820	0.0000	0.0000	0.0262	0.0159
	Grand Total for ALT 2	**50.4497**	**2.0034**	**0.0000**	**0.0001**	**3.7328**	**2.3300**

Tab R: Assumptions

Assumptions used to build the calculation spreadsheets can be found in the various references used.

Tab D – Ship Emissions: Steaming hours provided by the US Navy, AFTT Gray Ship Steaming Hours for Air Analysis.docx, 12 September, 2016.

Tab E – Training in State Waters: State water activities provided by US Navy, AFTT Inshore Events_08Feb2017_NAEMO WEB.xlsx.

Tab F – Inland Water Training Event and Locations: State water activities provided by US Navy, AFTT Inshore Events_08Feb2017_NAEMO WEB.xlsx.

Tab G – Aircraft Emissions: Data on LTOs and Cruise time provided by US Navy, NAVAIR Assumptions.docx, Marine Corps Training Cycle.xlsx, C2X sorties hours.xlsx, IKE C2X.xlsx, AFTT Training Air Analysis.xlsx.

Tab H – Munition Emissions: Munitions Usage Estimates provided by US Navy, AFTT Training Air Analysis.xlsx (March 29), January 2017. AFTT Inshore Events_08Feb2017_NAEMO Web.xlsx, and Appendix F, Final AFTT EIS.

Tab I – Ship and Boat Emission Factors: Data from Navy and MSC Marine Engine Fuel Consumption & Emissions Calculator, US Navy, October 2016

Tab J – Munition Emission Factors: Emission Factors from USEPA AP-42 Section 15 (various dates)

Tab K - Aircraft Emission Factors and Profiles: For information on aircraft references, see Tab O, Aircraft Engine Emission Factor Sources, except for F-35, derived from Lemoore Op AQ Calcs May 2014 in Final Environmental Impact Statement US Navy F-35C West Coast Homebasing, Vol II, Appendix D.

Tab L - Aircraft Activity – Testing: Provided by US Navy, NAVAIR Assumptions.docx, March 30, 2017.

Tab M - Aircraft Activity – Training: Provided by US Navy, AFTT Training Air Analysis.xlsx, March 30 2017; IKE C2X.xlsx, March 29 2017; C2X Sorties hours.xlsx, March 13 2017; Marine Corps training cycle.xlsx, March 29 2017.

Tab N - Aircraft Activity by Region: Provided by US Navy, AFTT Training Air Analysis.xlsx, March 30 2017; IKE C2X.xlsx, March 29 2017; C2X Sorties hours.xlsx, March 13 2017; Marine Corps training cycle.xlsx, March 29 2017, NAVAIR Assumptions.docx, March 30 2017.

Tab O - Aircraft Engine Emission Factor Sources

Tab P - Munition Activity Data: Munitions Usage Estimates provided by US Navy, AFTT Training Air Analysis.xlsx (March 29), AFTT Inshore Events_08Feb2017_NAEMO Web.xlsx, Appendix F, Draft AFTT EIS May 2017.

Tab Q – Baseline (V2 Preferred Alternative) Munition Summary: Atlantic Fleet Forces Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact

C.2 Record of Non-Applicability for Clean Air Act Conformity

Figure C-1. Navy Record of Non-Applicability (RONA) for Clean Air Act Conformity

The Proposed Action falls under the Record of Non-Applicability (RONA) category and is documented with this RONA.

Proposed Action

Action Proponent:	U.S. Navy, Fleet Forces Command
Location:	Jacksonville, Florida, and surrounding area
Proposed Action Name:	Atlantic Fleet Training and Testing

Proposed Action & Emissions Summary: The Proposed Action (Preferred Alternative, Alternative 1) involves operation of military aircraft, vessels, and small boats in order to achieve requisite training and testing requirements. Small boats and vessels would be operational in the riverine environment in the Jacksonville, Florida, locality. These nearshore activities generate emissions primarily through fossil fuel combustion from engine operation. Part of Nassau County, which is adjacent to Jacksonville, is nonattainment for sulfur dioxide. As a result, Proposed Action emissions were evaluated to assess compliance with the General Conformity Rule *de minimis* thresholds. Table C.2-1 provides a summary of the evaluation.

Table C.2-1: Proposed Action Sulfur Dioxide Emissions Compared to General Conformity Rule *de Minimis Thresholds (Tons Per Year)*

Annual Emissions	*SO_2*
Alternative 1	4.92
de minimis threshold	100
Potential Exceedance	No

Affected Air Basin:	Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region
Date RONA prepared:	3 August 2018
RONA prepared by:	Naval Facilities Engineering Command Atlantic

Proposed Action Exemptions

The Proposed Action is exempt from the General Conformity Rule requirements based on the determination that the emissions are below the *de minimis* threshold for SO_2.

Emissions Evaluation Conclusion

The U.S. Navy concludes that *de minimis* thresholds for sulfur dioxide would not be exceeded as a result of implementation of the Proposed Action. The emissions data supporting that conclusion is shown in Table C.2-1 above. The calculations, methodology, data, and references are contained in Section 3.1 and Appendix C of the Atlantic Fleet Training and Testing Environmental Impact Statement. Therefore, the Navy concludes that further formal Conformity Determination procedures are not required, resulting in this RONA.

RONA Approval: M S Dussia Date: 14 AUG 18

Mark Dussia

U.S. Fleet Forces Environmental Readiness Branch Head

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APPENDIX D
Acoustic and Explosive Concepts

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Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing Activities

TABLE OF CONTENTS

List of Figures

List of Tables

This section does not contain tables.

APPENDIX D ACOUSTIC AND EXPLOSIVE CONCEPTS

This section introduces basic principles and terminology for acoustics and explosives to help the reader understand the analyses presented in this Environmental Impact Statement/Overseas Environmental Impact Statement Draft (EIS/OEIS). This section briefly explains the transmission of sound and explosive energy; introduces some of the basic mathematical formulas used to describe propagation; and defines acoustical terms, abbreviations, and units of measurement. The difference between transmission of sound in water and in air is also discussed. Finally, it discusses methods used to analyze what animals may hear.

A number of other sources provide a more extensive background on acoustics and explosives than presented in this overview and are recommended for further inquiry. These include, but are not limited to:

- *Marine Mammals and Noise* (Richardson et al., 1995) for a general overview
- *Principles of Underwater Sound* (Urick, 1983), *Fundamentals of Acoustical Oceanography* (Medwin & Clay, 1998), and *Principles of Marine Bioacoustics* (Au & Hastings, 2008) for comprehensive explanations of underwater acoustics

D.1 TERMINOLOGY

The following terms are used in this document when discussing sound and the attributes of a sound source.

D.1.1 SOUND

Sound is produced when an elastic medium (such as air or water) is set into motion, typically by a vibrating object within the medium. As the object vibrates, its motion is transmitted to adjacent "particles" of the medium. The motion of these particles is transmitted to adjacent particles, and so on. The result is a mechanical disturbance (the "sound wave") that moves away from the source and propagates at a medium-dependent speed (the "sound speed"). As the sound wave travels through the medium, the individual particles of the medium oscillate about their original positions but do not actually move with the sound wave. As the particles of the medium move back and forth they create small changes about the original values of the medium density, pressure, and temperature.

Sound may be described by both physical and subjective attributes. Physical attributes, such as sound amplitude (Section D.1.4) and frequency (Section D.1.3), may be directly measured. Subjective (or sensory) attributes like loudness and pitch depend on an animal's perception of a sound. Physical attributes of a sound at a particular point are usually obtained by measuring pressure changes as sound waves pass.

D.1.2 SIGNAL VERSUS NOISE

When sound is purposely created to convey information, communicate, or obtain information about the environment, it is often referred to as a signal. Examples of sounds that could be considered signals are sonar pings, marine mammal vocalizations and echolocation clicks, tones used in hearing experiments, and small sonobuoy explosions used for submarine detection.

Noise is undesired sound (American National Standards Institute, 1994). Sounds produced by naval aircraft and vessel propulsion are considered noise because they represent possible inefficiencies and increased detectability. Whether a sound is perceived as noise often depends on the receiver (i.e., the animal or system that detects the sound). For example, small explosives and sonar used to generate sounds that can locate an enemy submarine produce signals that are useful to sailors engaged in anti-submarine warfare, but are assumed to be noise when detected by marine mammals.

The combination of all sounds at a particular location, whether these sources are located near or far, is ambient noise (American National Standards Institute, 1994). Ambient noise includes natural sources, such as sound from crashing waves, rain, and animals (e.g., snapping shrimp), and anthropogenic sources, such as seismic surveys and vessel noise.

D.1.3 Frequency and Wavelength

Frequency is the physical attribute most closely associated with the subjective attribute “pitch”; the higher the frequency, the higher the pitch. Frequency is defined by the number of oscillations in the sound pressure or particle motion per second. One hertz (Hz) is equal to one oscillation per second, and one kilohertz (kHz) is equal to 1,000 oscillations per second. Human hearing generally spans the frequency range from 20 Hz to 20 kHz. The frequency range of a sound is called its bandwidth.

Pure tones have energy at a constant, single frequency. Complex tones contain energy at multiple, discrete frequencies, rather than a single frequency. A harmonic of a sound at a particular frequency is a multiple of that frequency (e.g., harmonic frequencies of a 2 kHz tone are 4 kHz, 6 kHz, 8 kHz, etc.). A source operating at a nominal frequency may emit several harmonic frequencies, but at lower amplitudes. Some sources may also emit subharmonics; however, these are typically many orders of magnitude less powerful than at the center frequency. Sounds with large bandwidth (“broadband” sounds) have energy spread across many frequencies.

In this document, sounds are generally described as either low- (less than 1 kHz), mid- (1 kHz–10 kHz), high- (10 kHz–100 kHz), or very high- (greater than 100 kHz) frequency. Hearing ranges of marine animals (e.g., fish, birds, sea turtles, and marine mammals) are quite varied and are species-dependent. For example, some fish can hear sounds below 100 Hz and some species of marine mammals have hearing capabilities that extend above 100 kHz. Acoustic impact analyses must therefore focus not only on the sound amplitude (i.e., pressure or particle motion, see Section D.1.4), but on the sound frequency and the hearing capabilities of the species being considered.

The wavelength of a sound is the distance between wave peaks. Wavelength decreases as frequency increases. The frequency multiplied by the wavelength equals the speed of sound in a medium, as shown in this equation:

$$\text{Frequency } (s^{-1}) \times \text{wavelength (m)} = \text{sound speed (m/s)}$$

The approximate speed of sound in sea water is 1500 m/s and in air is 340 m/s, although speed varies depending on environmental conditions (e.g., pressure, temperature, and, in the case of sea water, salinity; see Section D.3.1, Speed of Sound).

D.1.4 Sound Amplitude

Sound amplitude is the physical attribute most closely associated with the subjective attribute loudness. Amplitude is related to the amount that the medium particles oscillate about their original positions and can be thought of as the “strength” of a sound (as the amplitude increases, the loudness also increases). As the sound wave travels, the particles of the medium oscillate but do not actually travel with the wave. The result is a mechanical disturbance (i.e., the sound wave) that propagates away from the sound source.

Sound amplitude is typically characterized by measuring the acoustic pressure or particle motion (see Section D.2, Sound Metrics).

D.1.5 Impulsive versus Non-Impulsive Sounds

Although no standard definitions exist, sounds may be broadly categorized as impulsive or non-impulsive. Impulsive sounds have short durations, rapid rise-times, broad frequency content, and high peak sound pressures. Impulsive sounds are often produced by processes involving a rapid release of energy or mechanical impacts (Hamernik & Hsueh, 1991). Explosions, air guns, weapon firing, and impact pile driving are examples of impulsive sound sources analyzed in this document. In contrast, sonars, vessel operation, vibratory pile driving, and underwater transducers lack the characteristics of impulsive sources and are thus examples of non-impulsive sound sources. Non-impulsive sounds can be essentially continuous, such as machinery noise, or intermittent, such as sonar pings.

D.1.6 Acoustic Impedance

Acoustic impedance is a property of the propagation medium (air, water, or tissue) that can be simply described as the opposition to flow of a pressure wave. Acoustic impedance is a function of the density and speed of sound in a medium. Sound transmits more readily through materials of similar acoustic impedance, such as water and animal tissue. When sound waves encounter a medium with different acoustic impedance (for example, an air-water interface), they reflect and refract (see Sections D.3.3.3, Refraction, and D.3.3.4 Reflection and Multipath Propagation), creating more complex propagation conditions. For example, sound traveling in air (low impedance) encountering the water surface (high impedance) will be largely reflected, preventing most sound energy in the air from being transmitted into the water. The impedance difference at the tissue-air interface in animals with gas-containing organs also makes these areas susceptible to damage when exposed to the shock wave near an explosion, since the transmission from high-impedance to low-impedance can result in large motion at the boundary.

D.1.7 Duty Cycle

Duty cycle describes the portion of time that a sound source actually generates sound. It is defined as the percentage of time during which a sound is generated over a total operational time period. For example, if a sonar source produces a one-second ping once every 10 seconds, the duty cycle is 10 percent. Duty cycles vary among different acoustic sources; in general, a low duty cycle could be considered 20 percent or less and a high duty cycle 80 percent or higher.

D.1.8 Resonance

Resonance occurs when an object is vibrated at a frequency near its “natural frequency” or resonant frequency. The resonant frequency can be considered the preferred frequency at which an object will oscillate at a greater magnitude than when exposed to other frequencies. In this document, resonance is considered in relation to the size of an air bubble or air cavity in an animal that is exposed to high pressure waves and the potential for injury. The natural frequencies of dolphin and beluga lungs near the surface are about 36 Hz and 30 Hz, respectively (Finneran, 2003), the natural frequency of lungs of a large whale would be lower, while the natural frequency of small air bubbles would be much higher. Resonant frequencies would tend to increase as an animal dives, since the increased water pressure would compress an air-filled structure and reduce its size.

D.2 Sound Metrics

The sound metrics described here are used in this document to quantify exposure to a sound or explosion.

D.2.1 Pressure

Sound pressure is the incremental variation in a medium's static pressure as a sound wave travels through it. Sound pressure is typically expressed in units of pascals (Pa) (1 Pa = 1 N/m^2 = 10 µbar = 1.45×10^{-4} psi), although explosive overpressure may also be described in pounds per square inch (psi).

Various sound pressure metrics are illustrated in Figure D-1 for (a) a non-impulsive sound (a pure tone in this illustration) and (b) an impulsive sound. As shown in Figure D-1, the non-impulsive sound has a relatively gradual rise in pressure from static pressure (the ambient pressure without the added sound), while the impulsive sound has a near-instantaneous rise to a high peak pressure. The peak pressure shown on both illustrations is the maximum absolute value of the instantaneous sound pressure during a specified time interval ("zero-to-peak" or "peak"), which accounts for the values of peak pressures below the static (ambient) pressure (American National Standards Institute, 2013). "Peak-to-peak" pressure is the difference between the maximum and minimum sound pressures. The root-mean-square (rms) value is often used to describe the average sound pressure level of sounds, and sound pressure levels provided in this EIS/OEIS are root-mean-square values unless otherwise specified. As the name suggests, this method takes the square root of the average squared sound pressure values over a time interval. The duration of this time interval can have a strong effect on the measured rms sound pressure for a given sound, especially where pressure levels vary significantly, as during an impulsive sound exposure. If the analysis duration includes a significant portion of the waveform after the sound pressure has returned to zero, the rms pressure would be relatively low. If the analysis duration includes only the highest pressures of the impulsive exposure, the rms value would be comparatively high. For this reason, it is important to specify the duration used to calculate the rms pressure for impulsive sounds.

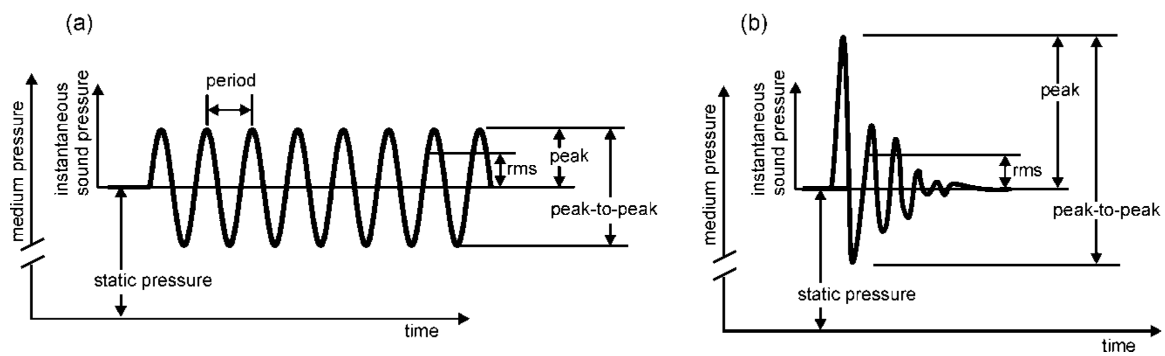


Figure D-1: Various Sound Pressure Metrics for a Hypothetical (a) Pure Tone (Non-Impulsive) and (b) Impulsive Sound

D.2.2 Sound Pressure Level

The most common sound level metric is sound pressure level (SPL). Because many animals can detect very large pressure ranges and judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound pressure level (SPL) is described by taking the logarithm of the ratio of the sound pressure to a reference pressure. Use of a logarithmic scale compresses the wide range of measured pressure values into a more useful scale.

Sound pressure levels are normally expressed in decibels (dB). A dB is 1/10 of a bel, a unit of level when the logarithm is to the base ten and the quantities concerned are proportional to power (American National Standards Institute, 2013). Sound pressure level in dBs is calculated as follows:

$$SPL = 20\log_{10}\left(\frac{P}{P_{ref}}\right)$$

where P is the sound pressure and P_{ref} is the reference pressure. Unless stated otherwise, the pressure P is the rms value of the pressure (American National Standards Institute, 2013). In some situations, SPL is calculated for the peak pressure rather than the rms pressure. On the occasions when rms pressure is not used, the pressure metric will be stated (e.g., peak SPL means an SPL calculated using the peak pressure rather than the rms pressure).

When a value is presented in dBs, it is important to also specify the value and units of the reference quantity. Normally the numeric value is given, followed by the text "re," meaning "with reference to," and the numeric value and unit of the reference quantity. For example, a pressure of 1 Pa, expressed in dBs with a reference of 1 micropascal (µPa), is written 120 dB re 1 µPa. The standard reference pressures are 1 µPa for water and 20 µPa for air. The reference pressure for air, 20 µPa, is the approximate lowest threshold of human hearing. It is important to note that because of the differences in reference units, the same sound pressures would result in different SPL values for each medium (the same sound pressure measured in water and in air would result in a higher SPL in water than in air, since the in-air reference is larger). Therefore, sound pressure levels in air and in water should never be directly compared.

D.2.3 SOUND EXPOSURE LEVEL

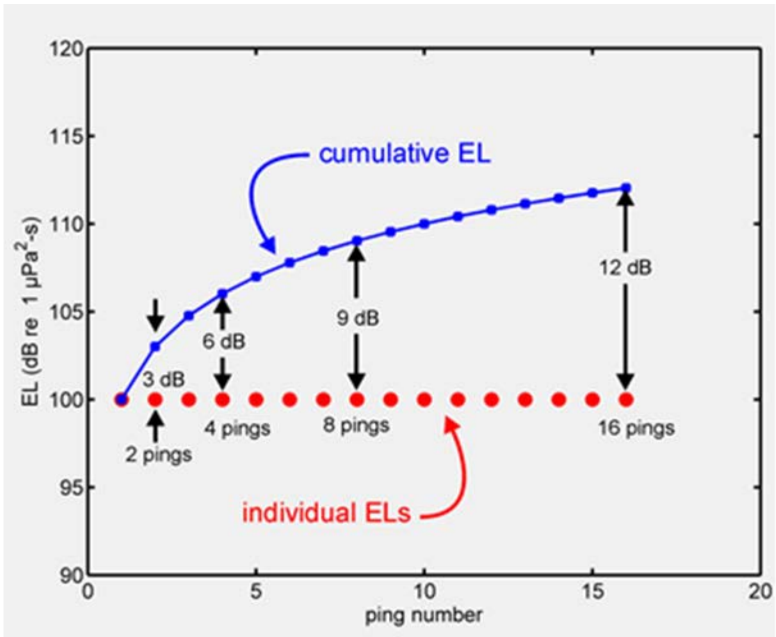
Sound exposure level (SEL) can be thought of as a composite metric that represents both the SPL of a sound and its duration. Individual time-varying noise events (e.g., a series of sonar pings or an impulsive sound) have two main characteristics: (1) a sound pressure that changes throughout the event and (2) a period of time during which the source is exposed to the sound. SEL can be provided for a single exposure (i.e., a single sonar ping or single explosive detonation) or for an entire acoustic event (i.e., multiple sonar pings or multiple explosive detonations). Cumulative SEL provides a measure of the net exposure of the entire acoustic event, but it does not directly represent the sound level heard at any given time. SEL is determined by calculating the dB level of the cumulative sum-of-squared pressures over the duration of a sound, with units of dB re 1 micropascal squared seconds (re 1 μPa^2-s) for sounds in water and dB re (20 micropascal) squared seconds [dB re $(20\ \mu Pa)^2$-s] for sounds in air.

Some rules of thumb for SEL are as follows:

- The numeric value of SEL is equal to the SPL of a 1-second sound that has the same total energy as the exposure event. If the sound duration is 1 second, SPL and SEL have the same numeric value (but not the same reference quantities). For example, a 1 second sound with an SPL of 100 dB re 1 µPa has a SEL of 100 dB re 1 μPa^2-s.
- If the sound duration is constant but the SPL changes, SEL will change by the same number of dBs as the SPL.
- If the SPL is held constant and the duration (T) changes, SEL will change as a function of $10\log_{10}(T)$:
  - o $10 \log_{10}(10) = 10$, so increasing duration by a factor of 10 raises SEL by 10 dB.

- o $10 \log_{10}(0.1) = -10$, so decreasing duration by a factor of 10 lowers SEL by 10 dB.
- o Since $10 \log_{10}(2) \approx 3$, so doubling the duration increases SEL by 3 dB.
- o $10 \log_{10}(1/2) \approx -3$, so halving the duration lowers SEL by 3 dB.

Figure D-2 illustrates the summation of energy for a succession of sonar pings. In this hypothetical case, each ping has the same duration and SPL. The SEL at a particular location from each individual ping is 100 dB re 1 µPa^2-s (red circles). The upper, blue curve shows the running total or cumulative SEL.

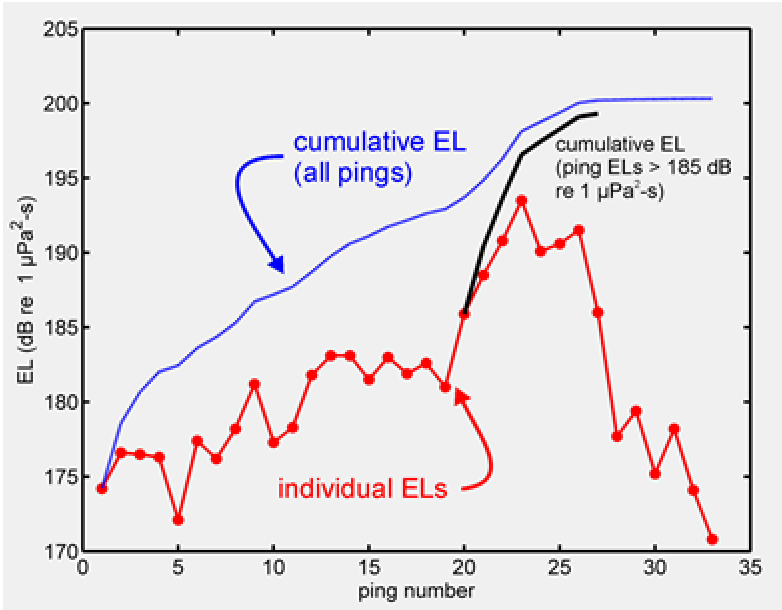


(EL = Exposure Level [i.e., Sound Exposure Level])

Figure D-2: Summation of Acoustic Energy from a Hypothetical, Intermittently Pinging, Stationary Sound Source

After the first ping, the cumulative SEL is 100 dB re 1 µPa^2-s. Since each ping has the same duration and SPL, receiving two pings is the same as receiving a single ping with twice the duration. The cumulative SEL from two pings is therefore 103 dB re 1 µPa^2-s. The cumulative SEL from four pings is 3 dB higher than the cumulative SEL from two pings, or 106 dB re 1 µPa^2-s. Each doubling of the number of pings increases the cumulative SEL by 3 dB.

Figure D-3 shows a more realistic example where the individual pings do not have the same SPL or SEL. These data were recorded from a stationary hydrophone as a sound source approached, passed, and moved away from the hydrophone. As the source approached the hydrophone, the received SPL from each ping increased, causing the SEL of each ping to increase. After the source passed the hydrophone, the received SPL and SEL from each ping decreased as the source moved farther away (downward trend of red line), although the cumulative SEL increased with each additional ping received (slight upward trend of blue line). The main contributions are from those pings with the highest individual SELs. Individual pings with SELs 10 dB or more below the ping with the highest level contribute little (less than 0.5 dB) to the total cumulative SEL. This is shown in Figure D-3, where only a small error is introduced by summing the energy from the eight individual pings with SEL greater than 185 dB re 1 µPa^2-s (black line), as opposed to including all pings (blue line).



(EL = Exposure Level [i.e., Sound Exposure Level])

Figure D-3: Cumulative Sound Exposure Level under Realistic Conditions with a Moving, Intermittently Pinging Sound Source

D.2.4 Particle Motion

The particles of a medium (e.g., water or air) oscillate around their original position as a sound wave passes. This motion is quantified using average displacement (m or dB re 1pm), velocity (m/s or dB re 1 nm/s^2), and acceleration (m/s^2 or dB re 1 µm/s^2) of the particles (Nedelec et al., 2016). Note that particle velocity is not the same as sound speed, which is how fast a sound wave moves through a medium. Particle motion is directional, whereas pressure measurement is not (Nedelec et al., 2016).

Far from a sound source and without any boundaries that could cause wave interference, particle velocity is directly proportional to sound pressure. Closer to a sound source, particle velocity begins to increase relative to sound pressure. Because this phenomena is related to wavelength, it may be relevant only when very close to sound sources with extremely low frequencies.

D.2.5 Impulse

Impulse is a metric used to describe the pressure and time component of a pressure wave. Impulse is typically only considered for high energy exposures to impulsive sources, such as exposures close to explosives. Specifically, positive impulse is the time integral of the initial peak positive pressure with units of Pascal-seconds (Pa-s). Impulse is a measured quantity that is distinct from the term “impulsive,” which is not a measurement term, but rather describes a type of sound.

D.3 Predicting How Sound Travels

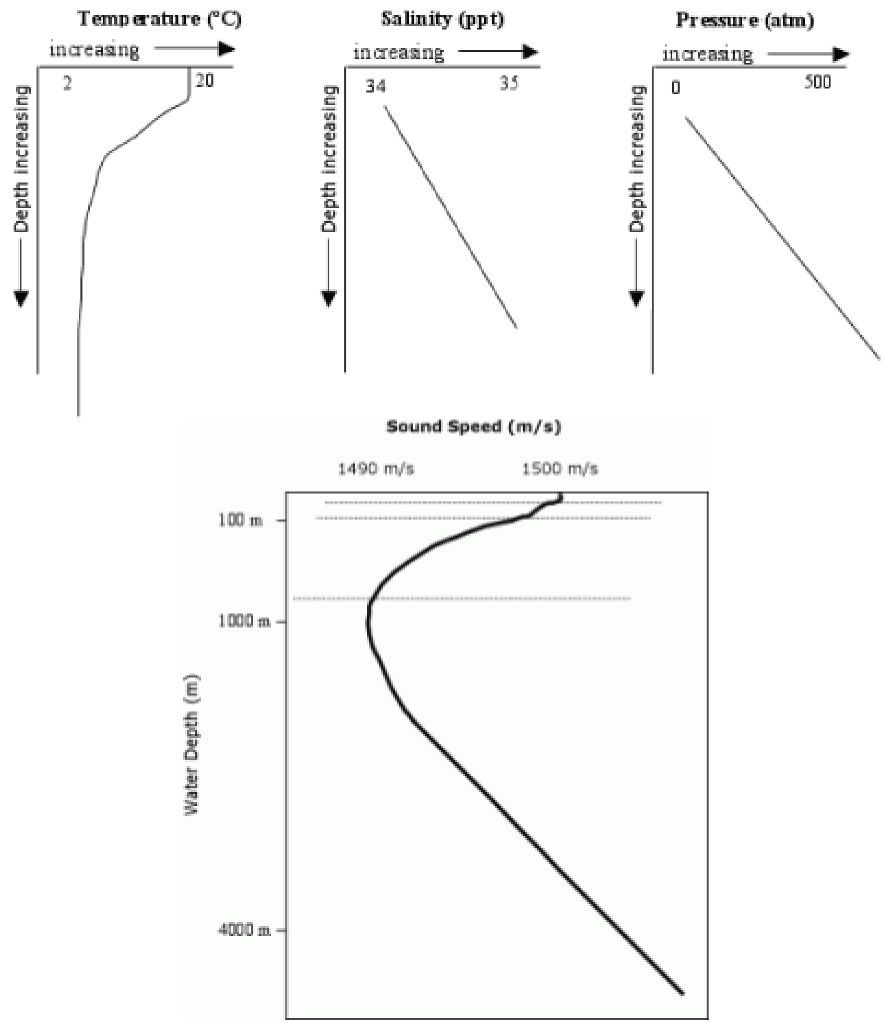
While the concept of a sound wave traveling from its source to a receptor is relatively simple, sound propagation is quite complex because of the simultaneous presence of numerous sound waves of different frequencies and source levels, and other phenomena such as reflections of sound waves and subsequent constructive (additive) or destructive (cancelling) interferences between reflected and incident waves. Other factors such as refraction, diffraction, bottom types, and surface conditions also affect sound propagation. While simple examples are provided here for illustration, the Navy Acoustic Effects Model used to quantify acoustic exposures to marine mammals and sea turtles takes into account the influence of multiple factors to predict acoustic propagation [see technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018)].

D.3.1 SPEED OF SOUND

The speed of sound is not affected by the SPL or frequency of the sound, but rather depends wholly on characteristics of the medium through which it is passing (e.g., the density and the compressibility). Sound travels faster through a medium that is harder to compress. For example, water is more difficult to compress than air, and sound travels approximately 340 m/s in air and 1,500 m/s in seawater.

The speed of sound in air is primarily influenced by temperature, relative humidity, and pressure, because these factors affect the density and compressibility of air. Generally, the speed of sound in air increases as air temperature increases.

The speed of sound in seawater also increases with increasing temperature and, to a lesser degree, with increasing hydrostatic pressure and salinity. Figure D-4 shows an example of how these attributes can change with depth. In seawater, temperature has the most important effect on sound speed for depths less than about 300 m. Below 1,500 m, the increasing hydrostatic pressure is the dominant factor because the water temperature is relatively constant. The variation of sound speed with depth in the ocean is called a sound velocity profile.



Source: http://blogs.oregonstate.edu/bioacoustics/2014/10/21/talk-weather/

Figure D-4: Sound Velocity Profile (Sound Speed) Is Related to Temperature, Salinity, and Hydrostatic Pressure of Seawater

D.3.2 Source Directivity

Most sonar and other active acoustic sources do not radiate sound in all directions. Rather, they emit sounds over a limited range of angles, in order to focus sound energy on a specific area or object of interest. The specific angles are sometimes given as horizontal or vertical beam width. Some sources can be described qualitatively as “forward-looking,” when sound energy is radiated in a limited direction in front of the source, or “downward-looking,” when sound energy is directed toward the bottom.

D.3.3 Sound Attenuation

As a sound wave passes through a medium, the sound level decreases with distance from the sound source. This phenomenon is known as attenuation, which is described in terms of transmission loss (TL). The transmission loss is used to relate the source SPL (SL), defined as the SPL produced by a sound source at a distance of one meter, and the received SPL (RL) at a particular location, as follows:

$$RL = SL - TL$$

The main contributors to sound attenuation are as follows (Urick, 1983):

- Geometric spreading of the sound wave as it propagates away from the source
- Sound absorption (conversion of sound energy into heat)
- Scattering, diffraction, multipath interference, and boundary effects

D.3.3.1 Geometrical Spreading Loss

Spreading loss is a geometric effect representing regular weakening of a sound wave as it spreads out from a source. Spreading describes the reduction in sound pressure caused by the increase in surface area as the distance from a sound source increases. Spherical and cylindrical spreading are common types of spreading loss.

In the simple case of sound propagating from a point source without obstruction or reflection, the sound waves take on the shape of an expanding sphere. An example of spherical spreading loss is shown in Figure D-5. As spherical propagation continues, the sound energy is distributed over an ever-larger area following the inverse square law: the pressure of a sound wave decreases inversely with the square of the distance between the source and the receptor. For example, doubling the distance between the receptor and a sound source results in a reduction in the pressure of the sound to one-fourth of its initial value; tripling the distance results in one-ninth of the original pressure, and so on. Since the surface area of a sphere is $4\pi r^2$, where r is the sphere radius, the change in SPL with distance r from the source is proportional to the radius squared. This relationship is known as the spherical spreading law. The transmission loss for spherical spreading between two locations is:

$$TL = 20 \log_{10} (r_2/r_1)$$

where r_1 and r_2 are distances from the source. Spherical spreading results in a 6 dB reduction in SPL for each doubling of distance from the sound source. For example, calculated transmission loss for spherical spreading is 40 dB at 100 m and 46 dB at 200 m.

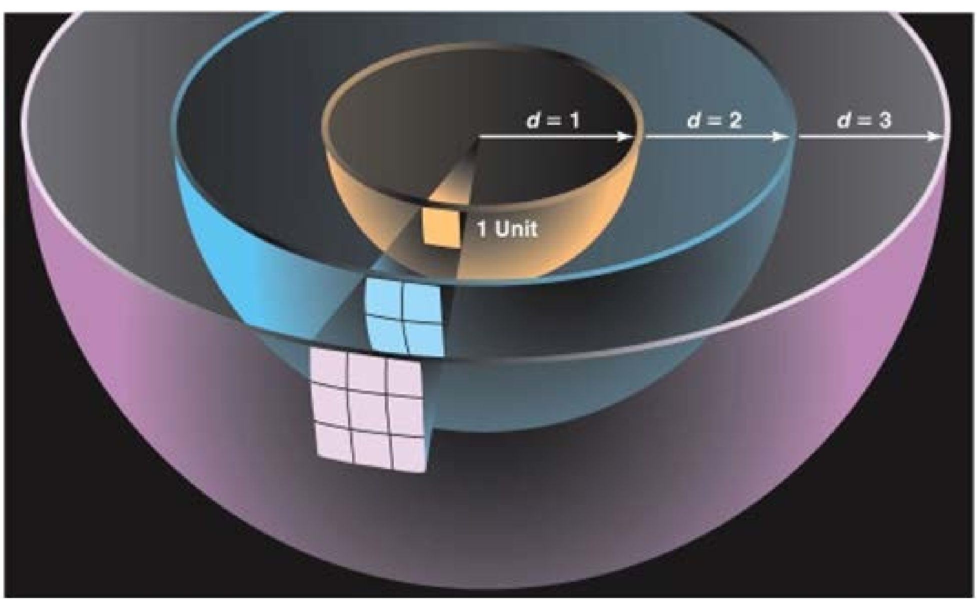


Figure D-5: Graphical Representation of the Inverse Square Relationship in Spherical Spreading

In cylindrical spreading, spherical waves expanding from the source are constrained by the water surface and the seafloor and take on a cylindrical shape. In this case the sound wave expands in the shape of a cylinder rather than a sphere, and the transmission loss is:

$$TL = 10\log_{10}(r_2/r_1)$$

Cylindrical spreading is an approximation of sound propagation in a water-filled channel with horizontal dimensions much larger than the depth. Cylindrical spreading predicts a 3 dB reduction in SPL for each doubling of distance from the source. For example, calculated transmission loss for cylindrical spreading is 30 dB at 1,000 m and 33 dB at 2,000 m.

The cylindrical and spherical spreading equations above represent two simple hypothetical cases. In reality, geometric spreading loss is more spherical near a source and more cylindrical with distance, and is better predicted using more complex models that account for environmental variables, such as the Navy Acoustic Effects Model [see technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018)].

However, when conducting simple spreading loss calculations in near shore environments, "practical spreading loss" can be applied, where:

$$TL = 15\log_{10}(r_2/r_1)$$

Practical spreading loss accounts for other realistic losses in the environment, such as absorption and scattering, which are not accounted for in geometrical spreading.

D.3.3.2 Absorption

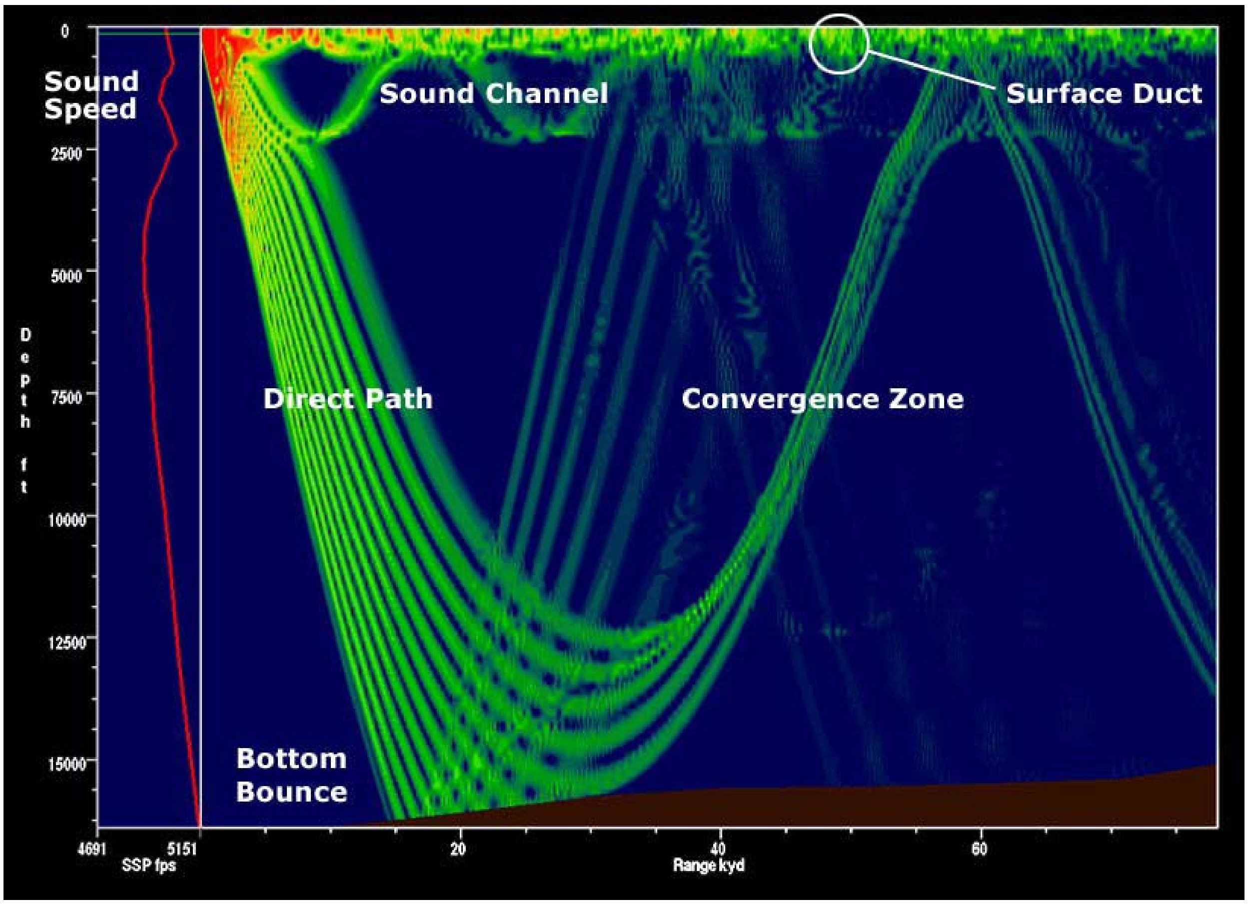
Absorption is the conversion of acoustic energy to kinetic energy in the particles of the propagation medium (Urick, 1983). Absorption is directly related to sound frequency, with higher frequencies having higher rates of absorption. Absorption rates range from 0.07 dB/km for a 1 kHz sound to about 30 dB/km for a 100 kHz sound. Therefore, absorption is the cause of a significant amount of attenuation for high and very high frequency sound sources, reducing the distance over which these sources may be perceived compared to mid- and low-frequency sound sources with the same source level.

D.3.3.3 Refraction

When a sound wave propagating in a medium encounters a second medium with a different density (e.g., the air-water boundary), part of the incident sound will be reflected back into the first medium and part will be transmitted into the second medium (Kinsler et al., 1982). The propagation direction will change as the sound wave enters the second medium; this phenomenon is called refraction. Refraction may also occur within a single medium if the properties of the medium change enough to cause a variation in the sound speed. Refraction of sound resulting from spatial variations in the sound speed is one of the most important phenomena that affect sound propagation in water (Urick, 1983).

As discussed in Section D.3.1 (Speed of Sound), the sound speed in the ocean primarily depends on hydrostatic pressure (i.e., depth) and temperature. Although the actual variations in sound speed are small, the existence of sound speed gradients in the ocean has an enormous effect on the propagation of sound in the ocean. If one pictures sound as rays emanating from an underwater source, the propagation of these rays changes as a function of the sound speed profile in the water column. Specifically, the directions of the rays bend toward regions of slower sound speed. This phenomenon creates ducts in which sound becomes "trapped," allowing it to propagate with high efficiency for large distances within certain depth boundaries. During winter months, the reduced sound speed at the surface due to cooling can create a surface duct that efficiently propagates sound such as commercial shipping noise (Figure D-6). Sources located within this surface duct can have their sounds trapped, but sources located below this layer would have their sounds refracted downward. The deep sound channel, or sound frequency and ranging (SOFAR) channel, is another duct that exists where sound speeds are slowest deeper in the water column (600–1,200 m depth at the mid-latitudes).

Similarly, the path of sound will bend toward regions of lower sound speed in air. Air temperature typically decreases with altitude, meaning sounds produced in air tend to bend skyward. When an atmospheric temperature inversion is present, air is cooler near the earth's surface. In inversion conditions, sound waves near the earth's surface will tend to refract downward.



[1 kiloyard (kyd) = 0.9 km]

Figure D-6: Sound Propagation Showing Multipath Propagation and Conditions for Surface Duct

D.3.3.4 Reflection and Multipath Propagation

In multipath propagation, sound may not only travel a direct path (with no reflection) from a source to a receiver, but also be reflected from the surface or bottom multiple times before reaching the receiver (Urick, 1983). Reflection is shown in Figure D-6 at the seafloor (bottom bounce) and at the water surface. At some distances, the reflected wave will be in phase with the direct wave (their waveforms add together) and at other distances the two waves will be out of phase (their waveforms cancel). The existence of multiple sound paths, or rays, arriving at a single point can result in multipath interference, a condition that permits the addition and cancellation between sound waves, resulting in the fluctuation of sound levels over short distances.

Reflection plays an important role in the pressures observed at different locations in the water column. Near the bottom, the direct path pressure wave may sum with the bottom-reflected pressure wave, increasing the exposure. Near the surface, however, the surface-reflected pressure wave may destructively interfere with the direct path pressure wave, "cutting off" the wave and reducing exposure (called the Lloyd mirror effect). This can cause the sound level to decrease dramatically within the top few meters of the water column.

D.3.3.5 Diffraction, Scattering, and Reverberation

Diffraction, scattering, and reverberation are examples of what happens when sound waves interact with obstacles in the propagation path.

Diffraction may be thought of as the change of direction of a sound wave as it passes around an obstacle. Diffraction depends on the size of the obstacle and the sound frequency. The wavelength of the sound must be larger than the obstacle for notable diffraction to occur. If the obstacle is larger than the wavelength of sound, an acoustic shadow zone will exist behind the obstacle where the sound is unlikely to be detected. Common examples of diffraction include sound heard from a source around the corner of a building and sound propagating through a small gap in an otherwise closed door or window.

An obstacle or inhomogeneity (e.g., smoke, suspended particles, gas bubbles due to waves, and marine life) in the path of a sound wave causes scattering as these inhomogeneities reradiate incident sound in a variety of directions (Urick, 1983). Reverberation refers to the prolongation of a sound, after the source has stopped emitting, caused by multiple reflections at water boundaries (surface and bottom) and scattering.

D.3.3.6 Surface and Bottom Effects

Because the sea surface reflects and scatters sound, it has a major effect on the propagation of underwater sound in applications where either the source or receiver is at a shallow depth (Urick 1983). If the sea surface is smooth, the reflected sound pressure is nearly equal to the incident sound pressure; however, if the sea surface is rough, the amplitude of the reflected sound wave will be reduced. Sound waves reflected from the sea surface experience a phase reversal. When the surface-reflected waves interact with the direct path waves near the surface, a destructive interference pattern is created in which the received pressure approaches zero.

The sea bottom is also a reflecting and scattering surface, similar to the sea surface. Sound interaction with the sea bottom is more complex, however, primarily because the acoustic properties of the sea bottom are more variable and the bottom is often layered into regions of differing density. As sound travels into the sea floor it reflects off of these different density layers in complex ways. For sources in contact with the bottom, such as during pile driving or bottom-placed explosives, a ground wave is produced that travels through the bottom sediment and may refract back into the water column.

For a hard bottom such as rock, the reflected wave will be approximately in phase with the incident wave. Thus, near the ocean bottom, the incident and reflected sound pressures may add together (constructive interference), resulting in an increased sound pressure near the sea bottom. Soft bottoms such as mud or sediment absorb sound waves and reduce the level in the water column overall.

D.3.3.7 Air-Water Interface

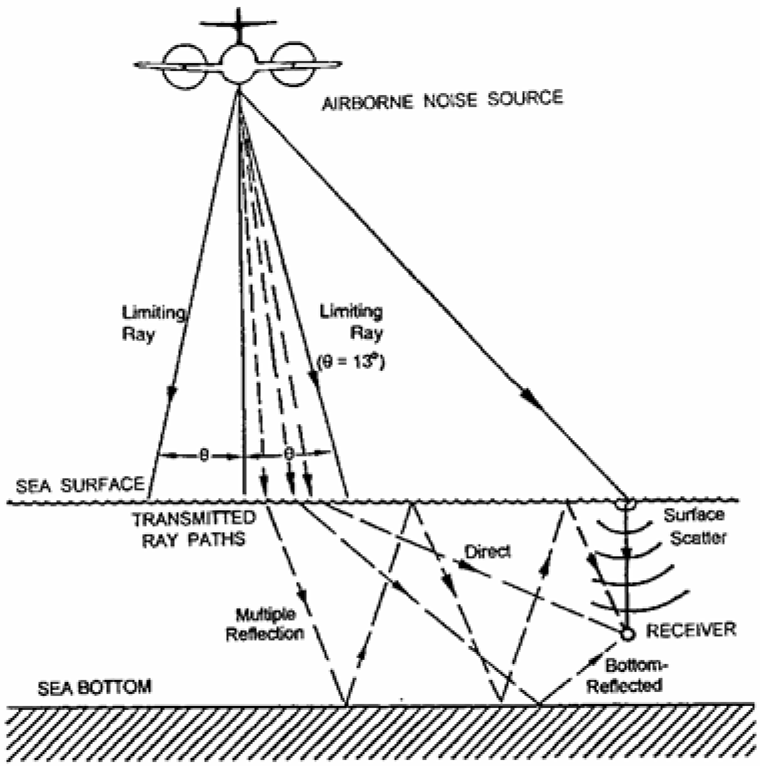
Sound from aerial sources such as aircraft and weapons firing may be transmitted into the water under certain conditions. The most studied of these sources are fixed-wing aircraft and helicopters, which create noise with most energy below 500 Hz. Noise levels in water are highest at the surface and are highly dependent on the altitude of the aircraft and the angle at which the aerial sound encounters the ocean surface. Transmission of the sound once it is in the water is identical to any other sound as described in the sections above.

Transmission of sound from a moving airborne source to a receptor underwater is influenced by numerous factors and has been addressed by Young (1973), Urick (1983), Richardson et al. (1995), Eller and Cavanagh (2000), Laney and Cavanagh (2000), and others. Sound is transmitted from an airborne source to a receptor underwater by four principal means: (1) a direct path, refracted upon passing through the air-water interface; (2) direct-refracted paths reflected from the bottom in shallow water; (3) evanescent transmission in which sound travels laterally close to the water surface; and (4) scattering from interface roughness due to wave motion.

When sound waves in air meet the water surface, the sound can either be transmitted across the air-water boundary or reflected off the water surface. When sound waves meet the water at a perpendicular angle (e.g., straight down from an in-air source to a flat water surface), the sound waves are both transmitted directly across the water surface in the same direction of travel and reflected 180° back toward the original direction of travel. This can creates a localized condition at the water surface where the incident and reflected waves sum, doubling the in-air overpressure (+ 6 dB). As the incident angle of the in-air sound wave changes from perpendicular, this phenomena is reduced, ultimately reaching the angle where sound waves are parallel to the water surface and there is no surface reflection.

The sound that enters the water is refracted due to the difference in sound velocity between air and water, as shown in Figure D-7. As the angle of the in-air incident wave moves away from perpendicular, the direction of travel of the underwater refracted waves becomes closer to parallel to the water surface. When the incident angle is reached where the underwater refracted sound wave is parallel to the water surface, all of the sound is reflected back into the air and no sound enters the water. This occurs at an angle of about 13-14°. As a result, most of the acoustic energy transmitted into the water through a relatively narrow cone extending vertically downward from the in-air source. The width of the footprint would be a function of the source altitude. Lesser amounts of sound may enter the water outside of this cone due to surface scattering (e.g., from water surface waves that can vary the angle of incidence over an area) and as evanescent waves that are only present very near the surface.

If a sound wave is ideally transmitted into water (that is, with no surface transmission loss, such as due to foamy, wave conditions that could decrease sound entering the water), the sound pressure level underwater is calculated by changing the pressure reference unit from 20 μPa in air to 1 μPa in water. For a sound with the same pressure in air and water, this calculation results in a +26 dB sound pressure level in water compared to air. For this reason, sound pressure levels in water and sound pressure levels in air should never be directly compared.



(Richardson et al. 1995)

Figure D-7: Characteristics of Sound Transmission Through the Air-Water Interface

D.4 AUDITORY PERCEPTION

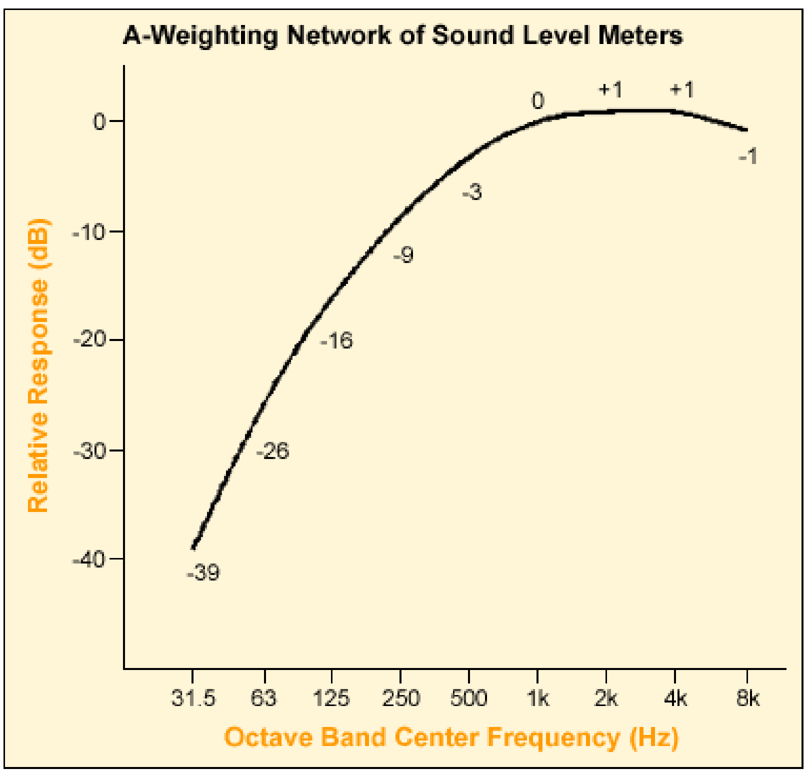
Animals with an eardrum or similar structure, including mammals, birds, and reptiles, directly detect the pressure component of sound. Some marine fish also have specializations to detect pressure changes, although most invertebrates and many marine fish do not have anatomical structures that enable them to detect the pressure component of sound and are only sensitive to the particle motion component of sound. This difference in acoustic energy sensing mechanisms limits the range at which these animals can detect most sound sources analyzed in this document. This is because far from a sound source (i.e., in the far field), particle velocity and sound pressure are directly proportional. But close to a source (i.e., in the near field), particle velocity increases relative to sound pressure and may become more detectable to certain animals. As sound frequency increases, the wavelength becomes shorter, resulting in a smaller near field.

Because mammalian ears can detect large pressure ranges and humans judge the relative loudness of sounds by the ratio of the sound pressures (a logarithmic behavior), sound amplitude is described by the SPL, calculated by taking the logarithm of the ratio of the sound pressure to a reference pressure (see Section D.2.2, Sound Pressure Level). Use of a logarithmic scale compresses the wide range of pressure values into a more usable numerical scale. On the dB scale, the smallest audible sound in air (near total silence) to a human is 0 dB re 20 µPa. If the sound intensity increases by a factor of 10, the SPL would increase to 10 dB re 20 µPa. If the sound intensity increases by a factor of 100, the SPL would increase to 20 dB re 20 µPa, and if the sound intensity increases by a factor of 1000, the SPL would be 30 dB re 20 µPa. A quiet conversation has an SPL of about 50 dB re 20 µPa, while the threshold of pain is around 120–140 dB re 20 µPa.

As described in Section D.2.2 (Sound Pressure Level), SPLs under water differ from those in air because they rely on different reference pressures in their calculation; therefore, the two should never be directly compared.

While sound pressure and frequency are physical measure of the sound, loudness is a subjective attribute that varies with not only sound pressure but also other attributes of the sound, such as frequency. For example, a human listener would perceive a 60 dB re 20 µPa sound at 2 kHz to be louder than a 60 dB re 20 µPa sound at 50 Hz, even though the SPLs are identical. This effect is most noticeable at lower sound pressure levels; however, at very high sound pressure levels, the difference in perceived loudness at different frequencies becomes smaller.

To account for differences in hearing sensitivity at various frequencies, acoustic risk analyses commonly use auditory weighting functions — mathematical functions that adjust (or "weight") received sound levels across sound frequency based on how the listener's sensitivity or susceptibility to sound changes at different frequencies. For humans, the most common weighting function is called "A-weighting" (see Figure D-8). A-weighted sound levels are specified in units of "dBA" (A-weighted decibels). For example, if the unweighted received level of a 500 Hz tone at a human receiver was 90 dB re 20 µPa, the A-weighted sound level would be 90 dB – 3 dB = 87 dBA because the A-weighting function amplitude at 500 Hz is -3 dB. Many measurements of sound in air appear as dBAs in the literature because the intent of the authors is to assess noise impacts on humans.



The Numbers along the Curve Indicate How a Received Sound Level Would Be Adjusted at that Frequency.

Figure D-8: A-weighting for Human Hearing of Sounds in Air (OSHA).

The auditory weighting concept can be applied to other species. When used in analyzing the impacts of sound on an animal, auditory weighting functions adjust received sound levels to emphasize ranges of best hearing and de-emphasize ranges of less or no sensitivity. Auditory weighting functions were developed for marine mammals and sea turtles and are used to assess acoustic impacts. For more information on weighting functions and their derivation for this analysis see technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis* (U.S. Department of the Navy, 2017).

D.5 EXPLOSIVES

Explosive materials used in Navy testing and training activities are either (1) “high explosives,” sometimes referred to as HE, which means that the explosive material has a very fast rate of detonation (exceeding the speed of sound), or (2) low explosives, which exhibit a relatively slow burn, or deflagration, such as black powder. Because low explosives are typically used in small quantities and have less destructive power, the below discussion focuses on high explosives.

This rate of detonation of a high explosive is highly supersonic, producing a high pressure, steep instantaneous shock wave front travelling through the explosive material. This shock front is produced by the supersonic expansion of the explosive products, but as the shock front travels away from the immediate area of the detonation, it begins to behave as an acoustic wave front travelling at the speed of sound.

The near-instantaneous rise from ambient to an extremely high peak pressure is what makes the explosive shock wave potentially damaging. The area under this positive pressure duration is calculated as the positive impulse.

The positive pressure produced by an explosion is also referred to as the overpressure. As the shock front passes a location, the positive pressure exponentially decays, as shown in Figure D-9. As the shock front travels away from the detonation, the waveform is stretched – the peak pressure decreases while the positive duration increases. The reduction in peak pressure reduces the rate at which the positive impulse is received. Both the reduction in peak pressure and stretching of the positive impulse reduce the potential for injury. In addition, absorption losses of higher frequencies over distance results in a softening of the shock front, such that the rise to peak pressure is no longer near-instantaneous.

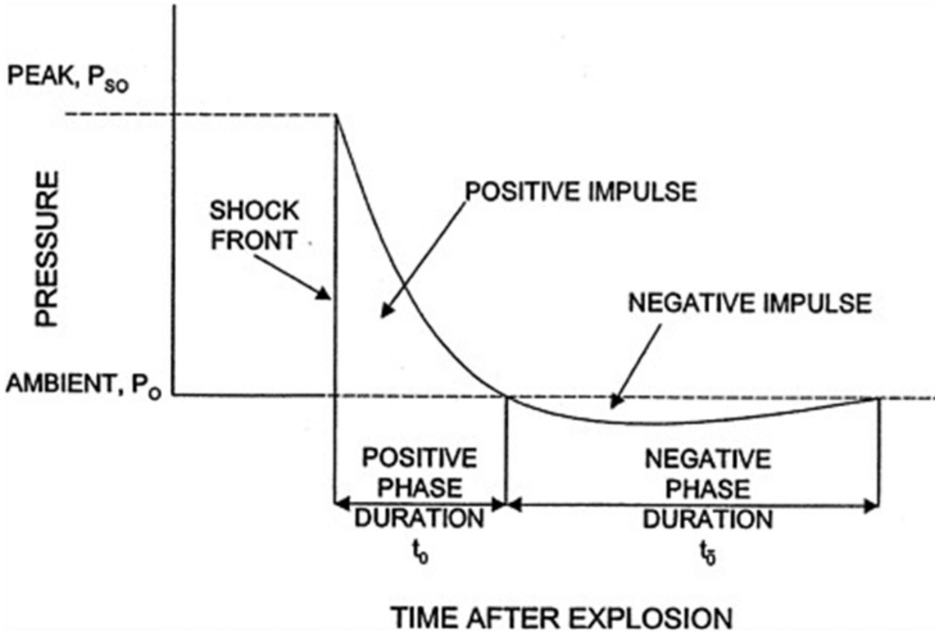


Figure D-9: Impulse Shown as a Function of Pressure over Duration at a Specific Location

The peak pressure experienced by a receptor (i.e., an animal) is a function of the explosive material, the net explosive weight, and the distance from the charge. Net explosive weight (NEW) is a way to classify and compare quantities of different explosive compounds. The net explosive weight for a charge is the energetic equivalent weight of trinitrotoluene (TNT). In general, shock wave effects near an explosive charge increase in proportion to the cube root of the explosive weight (Young, 1991). For example, shock wave impacts will double when the explosive charge weight is increased by a factor of eight (i.e., cube root of eight equals two). This relationship is known as the similarity principle, and the corresponding similitude equations allow for prediction of various explosive metrics for a given charge weight and material.

The similitude equations allow for a simple prediction of peak pressure in a uniform free field environment, and sources are provided below for using these equations for estimating explosive effects in air and in water. However, at longer distances or in more complex environments with boundaries and variations in the propagation medium, explosive propagation modeling is preferred.

D.5.1 Explosions in Air

Explosions in air produce an initial blast front that propagates away from the detonation. When pressure waves from an explosion in air meet the water surface, the pressure wave can be transmitted across the air-water boundary and reflected off the water surface. When pressure waves in air meet the water at a perpendicular angle (e.g., straight down from an in-air source to a flat water surface), the sound waves are both transmitted directly across the water surface in the same direction of travel and reflected 180° back toward the original direction of travel. For acoustic waves, this can create a localized condition at the water surface where the incident and reflected waves sum, doubling the in-air overpressure (+ 6 dB). For shock waves with high incident pressures travelling at supersonic speeds, the reflection from the water surface depends on the angle of incidence and the speed of the shock wave, and the reflected shock wave pressure can be greater than the incident shock wave pressure (Kinney & Graham, 1985; U.S. Department of the Navy, 1975).

In certain explosive geometries, depending on the size of the explosive and its height of detonation, a combined shock wave, called a Mach stem, can be created by the summing of the direct and reflected shock waves at larger angles of incidence (Kinney & Graham, 1985). In instances where this specific geometry does not occur, only the direct path wave is experienced because there is no surface reflection (waves are parallel to or angled away from the water surface, such as would occur when an explosive is detonated at the water surface), or separate direct and reflected pressure waves may be experienced.

D.5.1.1 Fragmentation

Missiles, rockets, projectiles, and other cased weapons will produce casing fragments upon detonation. These fragments may be of variable size and are ejected at supersonic speed from the detonation. The casing fragments will be ejected at velocities much greater than debris from any target due to the proximity of the casing to the explosive material. Unlike detonations on land targets, detonations during Navy training and testing would not result in other propelled materials such as crater debris.

Fragment density can be simply assumed to follow an inverse-square law with distance, in which the possibility of fragment strike is reduced by the square of the distance from the original detonation point. The forces of gravity and drag will further reduce the likelihood of strike with increasing distance than is accounted for in the inverse-square relationship (Zaker, 1975). The possible area of strike risk at any given distance from the detonation point is limited to the surface area of produced fragments, with drag and gravity reducing the number of produced fragments that travel to greater distances.

D.5.2 Explosions in Water

At the instant of explosion underwater, gas byproducts are generated at high pressure and temperature, creating a bubble. The heat causes a certain amount of water to vaporize, adding to the volume of the bubble. This action immediately begins to force the water in contact with the blast front in an outward direction, creating an intense, supersonic pressure shock wave. As the high-pressure wave travels away from the source, it slows to the speed of sound and acts like an acoustic wave similar to other impulsive sources that lack a strong shock wave (e.g., air guns). Explosions have the greatest amount of energy in lower frequencies below 500 Hz, although energy is present in frequencies exceeding 10 kHz (Urick, 1983). The higher frequency components exhibit more attenuation with distance due to absorption (see Section D.3.3.2, Absorption).

The shock wave caused by an explosion in deeper water may be followed by several bubble pulses in which the explosive byproduct gases expand and contract, with correlated high and low pressure oscillations. These bubble pulses lack the steep pressure front of the initial explosive pulse, but the first bubble pulse may still contribute to the total energy released at frequencies below 100 Hz (Urick, 1983). Subsequent bubble pulses contribute little to the total energy released during the explosion (Urick, 1983). If the detonation occurs at or just below the surface, a portion of the explosive power is released into the air and a pulsating gas bubble is not formed.

The pressure waves from an explosive can constructively add or destructively cancel each other in ocean environments with multi-path propagation, as described for acoustic waves in Section D.3.3.3 (Refraction) and Section D.3.3.4 (Reflection and Multipath Propagation). The received impulse is affected by the depth of the charge and the depth of the receiving animal. Pressure waves from the detonation may travel directly to the receiver or be reflected off the water surface before arriving at the receiver. If a charge is detonated closer to the surface or if an animal is closer to the surface, the time between the initial direct path arrival and the following surface-reflected tension wave arrival is reduced, resulting in a steep negative pressure cut-off of the initial direct path positive impulse exposure. Two animals at similar distances from a charge, therefore, may experience the same peak pressure but different levels of impulse at different depths.

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APPENDIX E
Estimated Marine Mammals and Sea Turtle Impacts from Exposure to Acoustic and Explosive Stressors Under Navy Training and Testing Activities

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Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

This section does not contain figures.

List of Tables

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APPENDIX E ESTIMATED MARINE MAMMALS AND SEA TURTLE IMPACTS FROM EXPOSURE TO ACOUSTIC AND EXPLOSIVE STRESSORS UNDER NAVY TRAINING AND TESTING ACTIVITIES

Navy training and testing activities would result in the incidental takes of marine mammals and sea turtles within the Study Area. The following appendix provides the estimated number of marine mammal and sea turtle impacts. Specifically, estimated impacts are derived from the quantitative analysis for activities under Alternatives 1 and 2 that involve the use of acoustic or explosive stressors. The quantitative analysis takes into account Navy activities, marine species density layers, acoustic modeling and other environmental parameters. A detailed explanation of the quantitative analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018). It is important to note that *impacts*, as discussed in this appendix, represent the estimated instances of take of marine mammals or sea turtles, not necessarily the number of individuals impacted (i.e., some marine mammals or sea turtles could be impacted several times, while others would not experience any impact). In addition, across training and testing activities, the five-year total impacts in each table may be more or less than the sum total of each year, given that; not all activities occur every year; some activities occur multiple times within a year; and some activities only occur a few times over the course of a 5-year period.

E.1 ESTIMATED MARINE MAMMALS IMPACTS FROM SONAR AND OTHER TRANSDUCERS UNDER NAVY TRAINING ACTIVITIES

Table E.1-1 provides a summary of the estimated number of marine mammal impacts from exposure to sonar and other transducers used during Navy training activities under Alternatives 1 and 2 over the course of a year.

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Suborder Mysticeti (baleen whales)										
Family Balaenidae (right whales)										
North Atlantic right whale*	Western North Atlantic	102	113	0	116	121	0	104	122	0
Family Balaenopteridae (roquals)										
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	8	15	0	8	18	0	10	22	0
Bryde's whale	Northern Gulf of Mexico	0	0	0	0	0	0	5	18	0
	NSD†	49	132	0	53	151	0	62	190	0
Minke whale	Canadian East Coast	453	1,670	0	482	1,930	0	570	2,448	1
Fin whale*	Western North Atlantic	517	884	0	533	933	0	679	1,242	0
Humpback whale	Gulf of Maine	64	138	0	68	151	0	74	180	0
Sei whale*	Nova Scotia	85	185	0	88	202	0	111	268	0
Suborder Odontoceti (toothed whales)										
Family Physeteridae (sperm whale)										
Sperm whale*	Gulf of Mexico Oceanic	24	0	0	24	0	0	1,691	40	0
	North Atlantic	13,246	306	0	13,753	326	0	16,730	395	0
Family Kogiidae (sperm whales)										
Dwarf sperm whale	Gulf of Mexico Oceanic	4	9	0	4	9	0	303	732	2
	Western North Atlantic	2,654	4,942	6	2,790	5,714	7	3,401	7,354	9

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Pygmy sperm whale	Northern Gulf of Mexico	4	9	0	4	9	0	303	732	2
	Western North Atlantic	2,654	4,942	6	2,790	5,714	7	3,401	7,354	9
Family Ziphiidae (beaked whales)										
Blainville's beaked whale	Northern Gulf of Mexico	35	0	0	35	0	0	1,324	18	0
	Western North Atlantic	11,924	91	0	12,430	102	0	15,348	121	0
Cuvier's beaked whale	Northern Gulf of Mexico	34	0	0	34	0	0	1,316	18	0
	Western North Atlantic	44,153	336	0	46,022	375	0	56,798	445	0
Gervais' beaked whale	Northern Gulf of Mexico	35	0	0	35	0	0	1,324	18	0
	Western North Atlantic	11,924	91	0	12,430	102	0	15,348	121	0
Northern bottlenose whale	Western North Atlantic	1,069	1	0	1,072	1	0	1,165	1	0
Sowerby’s beaked whale	Western North Atlantic	11,924	91	0	12,430	102	0	15,348	121	0
True's beaked whale	Western North Atlantic	11,924	91	0	12,430	102	0	15,348	121	0
Family Delphinidae (dolphins)										
Atlantic spotted dolphin	Northern Gulf of Mexico	910	10	0	934	11	0	4,459	263	0
	Western North Atlantic	105,106	7,214	0	110,164	7,703	0	129,196	9,158	0

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Atlantic white-sided dolphin	Western North Atlantic	13,180	828	0	13,592	900	0	17,011	1,145	0
Bottlenose dolphin	Choctawatchee Bay	7	0	0	7	0	0	7	0	0
	Gulf of Mexico Eastern Coastal	0	0	0	42	0	0	0	0	0
	Gulf of Mexico Northern Coastal	213	2	0	213	2	0	1,407	68	0
	Gulf of Mexico Western Coastal	59	2	0	3,617	530	0	110	3	0
	Indian River Lagoon Estuarine System	255	28	0	255	28	0	255	28	0
	Jacksonville Estuarine System	74	10	0	74	10	0	74	10	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0	0	0	0
	Northern Gulf of Mexico Continental Shelf	1,523	11	0	1,523	11	0	10,194	492	0
	Northern Gulf of Mexico Oceanic	185	2	0	185	2	0	1,171	56	0

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Northern North Carolina Estuarine System	969	97	0	2,762	457	0	969	97	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	791	38	0	862	42	0	1,030	49	0
	Western North Atlantic Central Florida Coastal	4,669	250	0	5,055	278	0	5,861	304	0
	Western North Atlantic Northern Migratory Coastal	22,944	1,853	1	23,236	1,883	1	25,436	2,023	1
	Western North Atlantic Offshore	260,221	19,975	9	284,072	22,890	9	306,627	23,312	9
	Western North Atlantic South Carolina/ Georgia Coastal	3,758	163	0	4,131	189	0	5,102	230	0
	Western North Atlantic Southern Migratory Coastal	10,005	482	1	11,705	674	1	12,875	637	1

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Clymene dolphin	Northern Gulf of Mexico	96	3	0	96	3	0	5,262	414	0
	Western North Atlantic	59,741	3,653	0	65,517	4,229	0	76,302	4,835	0
False killer whale	Northern Gulf of Mexico	40	1	0	40	1	0	1,797	126	0
	Western North Atlantic	7,101	394	0	7,806	462	0	9,431	548	0
Fraser's dolphin	Northern Gulf of Mexico	59	0	0	59	0	0	965	51	0
	Western North Atlantic	3,417	174	0	3,735	194	0	4,505	261	0
Killer whale	Northern Gulf of Mexico	1	0	0	1	0	0	79	4	0
	Western North Atlantic	69	3	0	74	3	0	85	4	0
Long-finned pilot whale	Western North Atlantic	15,547	769	0	16,188	845	0	19,650	1,023	0
Melon-headed whale	Northern Gulf of Mexico	68	2	0	68	2	0	5,675	413	0
	Western North Atlantic	31,876	1,762	0	35,103	2,039	0	41,994	2,416	0
Pantropical spotted dolphin	Northern Gulf of Mexico	549	16	0	549	16	0	54,726	4,152	0
	Western North Atlantic	124,754	7,402	0	136,727	8,382	0	163,807	10,173	0
Pygmy killer whale	Northern Gulf of Mexico	16	0	0	16	0	0	1,247	92	0
	Western North Atlantic	5,596	289	0	6,143	338	0	7,302	407	0

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities (continued)

		Alternative 1 – Minimum			*Alternative 1 – Maximum*			*Alternative 2*		
Species	***Stock***	***Behavioral Response***	***TTS***	***PTS***	***Behavioral Response***	***TTS***	***PTS***	***Behavioral Response***	***TTS***	***PTS***
Risso's dolphin	Northern Gulf of Mexico	38	1	0	38	1	0	1,931	140	0
	Western North Atlantic	18,315	996	0	19,878	1,150	0	24,998	1,440	0
Rough-toothed dolphin	Northern Gulf of Mexico	70	1	0	92	5	0	2,404	200	0
	Western North Atlantic	16,562	1,145	0	18,240	1,321	0	22,086	1,608	0
Short-beaked common dolphin	Western North Atlantic	188,458	14,716	0	200,722	17,303	0	253,413	21,443	0
Short-finned pilot whale	Northern Gulf of Mexico	35	1	0	35	1	0	1,293	71	0
	Western North Atlantic	27,798	1,361	0	29,823	1,527	0	36,002	1,783	0
Spinner dolphin	Northern Gulf of Mexico	221	7	0	221	7	0	26,750	2,122	0
	Western North Atlantic	62,660	3,930	0	69,130	4,541	0	82,700	5,473	0
Striped dolphin	Northern Gulf of Mexico	65	2	0	65	2	0	4,972	390	0
	Western North Atlantic	84,576	5,045	0	85,776	5,242	0	102,869	6,427	0
White-beaked dolphin	Western North Atlantic	36	1	0	38	2	0	36	1	0
Family Phocoenidae (porpoises)										
Harbor porpoise	Gulf of Maine/Bay of Fundy	21,448	6,957	11	22,043	7,147	12	24,835	8,260	13

Table E.1-1: Estimated Marine Mammal Impacts per Year from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Suborder Pinnipedia										
Family Phocidae (true seals)										
Gray seal	Western North Atlantic	416	1,005	0	437	1,007	0	416	1,009	0
Harbor seal	Western North Atlantic	675	1,630	0	708	1,633	0	675	1,636	0
Harp seal	Western North Atlantic	2,678	5,750	1	2,692	5,752	1	2,678	5,751	1
Hooded seal	Western North Atlantic	39	85	0	42	85	0	39	89	0
Order Sirenia										
Family Trichechidae (manatees)										
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

† NSD: No stock designated

PTS: permanent threshold shift; TTS: temporary threshold shift

E.2 Estimated Marine Mammal Impacts per Five Year Period from Sonar and Other Transducers Under Navy Training Activities

Table E.2-1 provides a summary of the estimated number of marine mammal impacts from exposure to sonar and other transducers used during Navy training activities under Alternatives 1 and 2 over the course of five years.

Table E.2-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Training Activities

Species	Stock	*Alternative 1 – 5-Year*			*Alternative 2 – 5-Year*		
		Behavioral Response	*TTS*	*PTS*	*Behavioral Response*	*TTS*	*PTS*
Suborder Mysticeti (baleen whales)							
Family Balaenidae (right whales)							
North Atlantic right whale*	Western North Atlantic	553	586	0	564	626	0
Family Balaenopteridae (roquals)							
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	40	81	0	49	111	0
Bryde's whale	Northern Gulf of Mexico	0	0	0	23	88	0
	NSD†	255	697	0	312	951	0
Minke whale	Canadian East Coast	2,325	8,871	0	2,852	12,238	3
Fin whale*	Western North Atlantic	2,619	4,518	0	3,400	6,210	0
Humpback whale	Gulf of Maine	330	717	0	377	900	0
Sei whale*	Nova Scotia	429	960	0	554	1,342	0
Suborder Odontoceti (toothed whales)							
Family Physeteridae (sperm whale)							
Sperm whale*	Gulf of Mexico Oceanic	118	0	0	8,456	202	0
	North Atlantic	67,244	1,570	0	83,653	1,974	0
Family Kogiidae (sperm whales)							
Dwarf sperm whale	Gulf of Mexico Oceanic	22	46	0	1,515	3,660	8
	Western North Atlantic	13,543	26,253	33	17,004	36,770	43
Pygmy sperm whale	Northern Gulf of Mexico	22	46	0	1,515	3,660	8
	Western North Atlantic	13,543	26,253	33	17,004	36,770	43

Table E.2-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Family Ziphiidae (beaked whales)							
Blainville's beaked whale	Northern Gulf of Mexico	173	0	0	6,621	92	0
	Western North Atlantic	60,631	477	0	76,743	603	0
Cuvier's beaked whale	Northern Gulf of Mexico	172	0	0	6,581	92	0
	Western North Atlantic	224,506	1,759	0	283,996	2,226	0
Gervais' beaked whale	Northern Gulf of Mexico	173	0	0	6,621	92	0
	Western North Atlantic	60,631	477	0	76,743	603	0
Northern bottlenose whale	Western North Atlantic	5,353	7	0	5,827	7	0
Sowerby's beaked whale	Western North Atlantic	60,631	477	0	76,743	603	0
True's beaked whale	Western North Atlantic	60,631	477	0	76,743	603	0
Family Delphinidae (dolphins)							
Atlantic spotted dolphin	Northern Gulf of Mexico	4,623	53	0	22,364	1,320	0
	Western North Atlantic	535,925	37,063	0	646,815	45,830	0
Atlantic white-sided dolphin	Western North Atlantic	66,763	4,287	0	85,168	5,727	0
Bottlenose dolphin	Choctawatchee Bay	33	0	0	33	0	0
	Gulf of Mexico Eastern Coastal	125	0	0	0	0	0
	Gulf of Mexico Northern Coastal	1,063	8	0	7,033	339	0
	Gulf of Mexico Western Coastal	10,969	1,592	0	11,223	1,600	0
	Indian River Lagoon	1,275	139	0	1,275	139	0

Table E.2-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Estuarine System						
	Jacksonville Estuarine System	372	49	0	372	49	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0
	Northern Gulf of Mexico Continental Shelf	7,615	54	0	50,970	2,461	0
	Northern Gulf of Mexico Oceanic	923	8	0	5,854	280	0
	Northern North Carolina Estuarine System	10,223	1,567	0	10,223	1,567	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	4,115	201	0	5,199	250	0
	Western North Atlantic Central Florida Coastal	24,234	1,320	0	29,656	1,565	0
	Western North Atlantic Northern Migratory Coastal	115,493	9,340	3	127,753	10,160	3
	Western North Atlantic Offshore	1,359,881	107,210	43	1,566,355	121,070	43
	Western North Atlantic South Carolina/ Georgia Coastal	19,640	879	0	25,821	1,189	0
	Western North Atlantic	54,540	2,947	3	67,722	3,650	3

Table E.2-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Training Activities (continued)

Species	Stock	*Alternative 1 – 5-Year*			*Alternative 2 – 5-Year*		
		Behavioral Response	*TTS*	*PTS*	*Behavioral Response*	*TTS*	*PTS*
	Southern Migratory Coastal						
Clymene dolphin	Northern Gulf of Mexico	480	15	0	26,310	2,068	0
	Western North Atlantic	310,453	19,435	0	382,097	24,238	0
False killer whale	Northern Gulf of Mexico	202	6	0	8,985	632	0
	Western North Atlantic	36,930	2,108	0	47,201	2,746	0
Fraser's dolphin	Northern Gulf of Mexico	296	0	0	4,825	254	0
	Western North Atlantic	17,722	911	0	22,527	1,307	0
Killer whale	Northern Gulf of Mexico	4	0	0	394	22	0
	Western North Atlantic	356	16	0	426	21	0
Long-finned pilot whale	Western North Atlantic	79,018	3,999	0	98,254	5,114	0
Melon-headed whale	Northern Gulf of Mexico	342	10	0	28,375	2,063	0
	Western North Atlantic	165,918	9,376	0	210,222	12,113	0
Pantropical spotted dolphin	Northern Gulf of Mexico	2,745	79	0	273,629	20,760	0
	Western North Atlantic	647,721	38,972	0	819,049	50,868	0
Pygmy killer whale	Northern Gulf of Mexico	82	0	0	6,236	461	0
	Western North Atlantic	29,087	1,544	0	36,544	2,039	0
Risso's dolphin	Northern Gulf of Mexico	192	5	0	9,657	698	0
	Western North Atlantic	94,702	5,289	0	124,991	7,202	0
Rough-toothed dolphin	Northern Gulf of Mexico	418	16	0	12,087	1,011	0
	Western North Atlantic	86,203	6,080	0	110,536	8,052	0

Table E.2-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Short-beaked common dolphin	Western North Atlantic	966,841	78,755	0	1,267,132	107,218	0
Short-finned pilot whale	Northern Gulf of Mexico	175	4	0	6,464	356	0
	Western North Atlantic	143,040	7,138	0	180,010	8,913	0
Spinner dolphin	Northern Gulf of Mexico	1,103	33	0	133,750	10,609	0
	Western North Atlantic	326,368	20,886	0	413,886	27,409	0
Striped dolphin	Northern Gulf of Mexico	326	10	0	24,859	1,948	0
	Western North Atlantic	425,279	25,620	0	514,348	32,134	0
White-beaked dolphin	Western North Atlantic	184	8	0	185	8	0
Family Phocoenidae (porpoises)							
Harbor porpoise	Gulf of Maine/Bay of Fundy	108,959	35,338	58	125,761	41,817	68
Suborder Pinnipedia							
Family Phocidae (true seals)							
Gray seal	Western North Atlantic	2,142	5,030	0	2,143	5,050	0
Harbor seal	Western North Atlantic	3,473	8,158	0	3,475	8,190	0
Harp seal	Western North Atlantic	13,431	28,757	4	13,431	28,760	4
Hooded seal	Western North Atlantic	204	427	0	207	447	0
Order Sirenia							
Family Trichechidae (manatees)							
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designation

PTS: permanent threshold shift; TTS: temporary threshold shift

E.3 Estimated Marine Mammal Impacts from Sonar and Other Transducers Under Navy Testing Activities

Table E.3-1 provides a summary of the estimated number of marine mammal impacts from exposure to sonar and other transducers used during Navy testing activities under Alternatives 1 and 2 over the course of a year.

Table E.3-1: Estimated Marine Mammal Impacts per Year from Sonar Testing Activities

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Suborder Mysticeti (baleen whales)										
Family Balaenidae (right whales)										
North Atlantic right whale*	Western North Atlantic	79	126	0	87	127	0	87	127	0
Family Balaenopteridae (roquals)										
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	3	16	0	4	16	0	4	16	0
Bryde's whale	Northern Gulf of Mexico	23	27	0	24	27	0	24	27	0
	NSD†	21	99	0	24	100	0	24	100	0
Minke whale	Canadian East Coast	284	1,285	1	314	1,289	1	315	1,290	1
Fin whale*	Western North Atlantic	1,034	2,406	2	1,183	2,434	2	1,189	2,435	2
Humpback whale	Gulf of Maine	165	300	0	180	302	0	181	302	0
Sei whale*	Nova Scotia	136	316	0	157	320	0	157	320	0
Suborder Odontoceti (toothed whales)										
Family Physeteridae (sperm whale)										
Sperm whale*	Gulf of Mexico Oceanic	993	23	0	1,083	23	0	1,076	23	0
	North Atlantic	9,431	325	0	10,946	327	0	10,968	327	0
Family Kogiidae (sperm whales)										
Dwarf sperm whale	Gulf of Mexico Oceanic	292	362	1	331	382	1	326	380	1
	Western North Atlantic	931	3,202	7	1,081	3,260	7	1,074	3,254	7

Table E.3-1: Estimated Marine Mammal Impacts per Year from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Pygmy sperm whale	Northern Gulf of Mexico	292	362	1	331	382	1	326	380	1
	Western North Atlantic	931	3,202	7	1,081	3,260	7	1,074	3,254	7
Family Ziphiidae (beaked whales)										
Blainville's beaked whale	Northern Gulf of Mexico	1,305	7	0	1,385	7	0	1,383	7	0
	Western North Atlantic	9,435	92	0	10,471	92	0	10,520	92	0
Cuvier's beaked whale	Northern Gulf of Mexico	1,357	7	0	1,453	7	0	1,447	7	0
	Western North Atlantic	34,634	340	0	38,433	341	0	38,614	341	0
Gervais' beaked whale	Northern Gulf of Mexico	1,305	7	0	1,385	7	0	1,383	7	0
	Western North Atlantic	9,435	92	0	10,471	92	0	10,520	92	0
Northern bottlenose whale	Western North Atlantic	853	3	0	968	3	0	976	3	0
Sowerby's beaked whale	Western North Atlantic	9,457	92	0	10,499	92	0	10,547	92	0
True's beaked whale	Western North Atlantic	9,457	92	0	10,499	92	0	10,547	92	0
Family Delphinidae (dolphins)										
Atlantic spotted dolphin	Northern Gulf of Mexico	67,680	3,554	0	68,265	3,563	0	68,257	3,563	0
	Western North Atlantic	84,352	11,489	0	97,925	11,516	0	96,533	11,514	0
Atlantic white-sided dolphin	Western North Atlantic	27,602	1,274	0	30,468	1,284	0	30,597	1,284	0

Table E.3-1: Estimated Marine Mammal Impacts per Year from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Bottlenose dolphin	Choctawatchee Bay	932	31	0	933	31	0	933	31	0
	Gulf of Mexico Eastern Coastal	0	0	0	0	0	0	0	0	0
	Gulf of Mexico Northern Coastal	15,297	812	0	15,418	813	0	15,418	813	0
	Gulf of Mexico Western Coastal	3,459	100	0	3,571	102	0	3,571	102	0
	Indian River Lagoon Estuarine System	0	3	0	0	3	0	0	3	0
	Jacksonville Estuarine System	0	3	0	0	3	0	0	3	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	1	0	0	1	0	0	1	0	0
	Northern Gulf of Mexico Continental Shelf	118,763	6,125	0	119,608	6,135	0	119,608	6,135	0
	Northern Gulf of Mexico Oceanic	13,383	672	0	13,749	674	0	13,674	674	0
	Northern North Carolina Estuarine System	80	26	0	80	26	0	80	26	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	273	46	0	282	47	0	285	47	0

Table E.3-1: Estimated Marine Mammal Impacts per Year from Sonar Testing Activities (continued)

		Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
Species	Stock	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Western North Atlantic Central Florida Coastal	1,999	229	0	2,041	229	0	2,055	229	0
	Western North Atlantic Northern Migratory Coastal	9,768	1,107	1	10,725	1,108	1	10,754	1,108	1
	Western North Atlantic Offshore	99,614	11,276	5	108,400	11,289	5	107,629	11,288	5
	Western North Atlantic South Carolina/ Georgia Coastal	1,366	221	0	1,409	221	0	1,423	221	0
	Western North Atlantic Southern Migratory Coastal	3,524	609	0	3,607	610	0	3,639	610	0
Clymene dolphin	Northern Gulf of Mexico	3,798	85	0	4,077	87	0	4,058	86	0
	Western North Atlantic	29,628	3,533	0	32,412	3,539	0	32,121	3,539	0
False killer whale	Northern Gulf of Mexico	1,764	69	0	1,862	69	0	1,855	69	0
	Western North Atlantic	3,085	394	0	3,368	395	0	3,323	395	0
Fraser's dolphin	Northern Gulf of Mexico	1,012	55	0	1,064	56	0	1,060	56	0
	Western North Atlantic	1,092	96	0	1,196	96	0	1,189	96	0
Killer whale	Northern Gulf of Mexico	29	0	0	32	0	0	32	0	0

Table E.3-1: Estimated Marine Mammal Impacts per Year from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Western North Atlantic	33	3	0	39	3	0	38	3	0
Long-finned pilot whale	Western North Atlantic	17,178	793	0	19,696	797	0	19,779	797	0
Melon-headed whale	Northern Gulf of Mexico	2,770	57	0	2,999	59	0	2,984	59	0
	Western North Atlantic	13,696	1,725	0	14,946	1,729	0	14,763	1,729	0
Pantropical spotted dolphin	Northern Gulf of Mexico	23,040	538	0	25,371	549	0	25,046	548	0
	Western North Atlantic	61,398	6,861	0	70,526	6,883	0	69,896	6,876	0
Pygmy killer whale	Northern Gulf of Mexico	650	15	0	704	15	0	700	15	0
	Western North Atlantic	2,327	288	0	2,557	288	0	2,527	288	0
Risso's dolphin	Northern Gulf of Mexico	1,491	40	0	1,609	40	0	1,600	40	0
	Western North Atlantic	17,309	1,053	0	19,004	1,057	0	18,987	1,057	0
Rough-toothed dolphin	Northern Gulf of Mexico	3,610	166	0	3,755	167	0	3,744	167	0
	Western North Atlantic	7,021	1,145	0	7,612	1,146	0	7,526	1,146	0
Short-beaked common dolphin	Western North Atlantic	311,228	12,932	0	339,800	12,986	0	341,100	12,991	0
Short-finned pilot whale	Northern Gulf of Mexico	1,652	21	0	1,800	22	0	1,785	22	0
	Western North Atlantic	14,564	1,096	0	15,896	1,099	0	15,872	1,099	0

Table E.3-1: Estimated Marine Mammal Impacts per Year from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Spinner dolphin	Northern Gulf of Mexico	6,834	226	0	7,581	230	0	7,525	230	0
	Western North Atlantic	26,997	3,795	0	29,517	3,801	0	29,104	3,800	0
Striped dolphin	Northern Gulf of Mexico	2,219	61	0	2,384	63	0	2,378	62	0
	Western North Atlantic	80,813	6,676	0	95,297	6,703	0	95,763	6,702	0
White-beaked dolphin	Western North Atlantic	40	2	0	42	2	0	42	2	0
Family Phocoenidae (porpoises)										
Harbor porpoise	Gulf of Maine/Bay of Fundy	96,211	12,102	23	110,744	13,433	25	111,627	13,433	25
Suborder Pinnipedia										
Family Phocidae (true seals)										
Gray seal	Western North Atlantic	338	514	2	366	516	2	366	516	2
Harbor seal	Western North Atlantic	548	834	3	593	836	3	594	836	3
Harp seal	Western North Atlantic	3,290	4,170	0	3,613	4,173	0	3,626	4,174	0
Hooded seal	Western North Atlantic	364	376	0	403	379	0	407	379	0
Order Sirenia										
Family Trichechidae (manatees)										
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designated

PTS: permanent threshold shift; TTS: temporary threshold shift

E.4 Estimated Marine Mammal Impacts per Five Year Period from Sonar and Other Transducers Under Navy Testing Activities

Table E.4-1 provides a summary of the estimated number of marine mammal impacts from exposure to sonar and other transducers used during Navy testing activities under Alternatives 1 and 2 over the course of five years.

Table E.4-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Testing Activities

		Alternative 1 – 5-Year			*Alternative 2 – 5-Year*		
Species	***Stock***	***Behavioral Response***	***TTS***	***PTS***	***Behavioral Response***	***TTS***	***PTS***
Suborder Mysticeti (baleen whales)							
Family Balaenidae (right whales)							
North Atlantic right whale*	Western North Atlantic	410	633	0	436	636	0
Family Balaenopteridae (roquals)							
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	17	78	0	19	78	0
Bryde's whale	Northern Gulf of Mexico	118	136	0	121	136	0
	NSD[†]	110	498	0	119	499	0
Minke whale	Canadian East Coast	1,475	6,433	3	1,575	6,451	3
Fin whale*	Western North Atlantic	5,453	12,086	9	5,935	12,175	9
Humpback whale	Gulf of Maine	853	1,505	0	904	1,511	0
Sei whale*	Nova Scotia	718	1,587	0	785	1,600	0
Suborder Odontoceti (toothed whales)							
Family Physeteridae (sperm whale)							
Sperm whale*	Gulf of Mexico Oceanic	5,124	114	0	5,389	114	0
	North Atlantic	50,008	1,628	0	54,799	1,633	0
Family Kogiidae (sperm whales)							
Dwarf sperm whale	Gulf of Mexico Oceanic	1,511	1,843	5	1,624	1,901	5
	Western North Atlantic	4,875	16,087	34	5,373	16,253	34
Pygmy sperm whale	Northern Gulf of Mexico	1,511	1,843	5	1,624	1,901	5
	Western North Atlantic	4,875	16,087	34	5,373	16,253	34

Table E.4-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Testing Activities (continued)

Species	Stock	*Alternative 1 – 5-Year*			*Alternative 2 – 5-Year*		
		Behavioral Response	*TTS*	*PTS*	*Behavioral Response*	*TTS*	*PTS*
Family Ziphiidae (beaked whales)							
Blainville's beaked whale	Northern Gulf of Mexico	6,677	33	0	6,918	33	0
	Western North Atlantic	49,178	461	0	52,574	462	0
Cuvier's beaked whale	Northern Gulf of Mexico	6,955	33	0	7,241	33	0
	Western North Atlantic	180,501	1,700	0	192,959	1,703	0
Gervais' beaked whale	Northern Gulf of Mexico	6,677	33	0	6,918	33	0
	Western North Atlantic	49,178	461	0	52,574	462	0
Northern bottlenose whale	Western North Atlantic	4,471	14	0	4,854	14	0
Sowerby's beaked whale	Western North Atlantic	49,295	461	0	52,709	462	0
True's beaked whale	Western North Atlantic	49,295	461	0	52,709	462	0
Family Delphinidae (dolphins)							
Atlantic spotted dolphin	Northern Gulf of Mexico	315,739	17,787	0	317,623	17,816	0
	Western North Atlantic	446,418	57,490	0	484,209	57,564	0
Atlantic white-sided dolphin	Western North Atlantic	143,547	6,388	0	152,840	6,419	0
Bottlenose dolphin	Choctawatchee Bay	4,255	155	0	4,259	155	0
	Gulf of Mexico Eastern Coastal	0	0	0	0	0	0
	Gulf of Mexico Northern Coastal	72,240	4,063	0	72,622	4,067	0
	Gulf of Mexico Western Coastal	17,509	504	0	17,853	509	0

Table E.4-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Indian River Lagoon Estuarine System	0	14	0	0	14	0
	Jacksonville Estuarine System	0	13	0	0	13	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	3	0	0	3	0	0
	Northern Gulf of Mexico Continental Shelf	563,290	30,645	0	565,966	30,675	0
	Northern Gulf of Mexico Oceanic	63,756	3,364	0	64,791	3,368	0
	Northern North Carolina Estuarine System	402	131	0	402	131	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	1,380	232	0	1,420	233	0
	Western North Atlantic Central Florida Coastal	9,794	1,144	0	9,995	1,145	0
	Western North Atlantic Northern Migratory Coastal	50,680	5,537	3	53,746	5,540	3
	Western North Atlantic Offshore	509,264	56,396	27	534,968	56,431	27

Table E.4-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Western North Atlantic South Carolina/ Georgia Coastal	6,901	1,104	0	7,101	1,105	0
	Western North Atlantic Southern Migratory Coastal	17,758	3,047	0	18,171	3,049	0
Clymene dolphin	Northern Gulf of Mexico	19,485	427	0	20,308	432	0
	Western North Atlantic	152,208	17,672	0	160,211	17,691	0
False killer whale	Northern Gulf of Mexico	8,771	345	0	9,060	347	0
	Western North Atlantic	15,731	1,970	0	16,530	1,973	0
Fraser's dolphin	Northern Gulf of Mexico	5,037	277	0	5,193	278	0
	Western North Atlantic	5,586	480	0	5,913	481	0
Killer whale	Northern Gulf of Mexico	150	0	0	158	0	0
	Western North Atlantic	173	15	0	189	15	0
Long-finned pilot whale	Western North Atlantic	90,679	3,972	0	98,724	3,985	0
Melon-headed whale	Northern Gulf of Mexico	14,252	289	0	14,931	293	0
	Western North Atlantic	69,856	8,632	0	73,369	8,642	0
Pantropical spotted dolphin	Northern Gulf of Mexico	118,718	2,709	0	125,371	2,739	0
	Western North Atlantic	321,363	34,335	0	349,592	34,380	0
Pygmy killer whale	Northern Gulf of Mexico	3,342	73	0	3,501	74	0
	Western North Atlantic	11,977	1,440	0	12,638	1,441	0
Risso's dolphin	Northern Gulf of Mexico	7,618	200	0	7,964	202	0

Table E.4-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
	Western North Atlantic	88,695	5,273	0	93,963	5,285	0
Rough-toothed dolphin	Northern Gulf of Mexico	17,637	831	0	18,069	835	0
	Western North Atlantic	35,731	5,727	0	37,424	5,730	0
Short-beaked common dolphin	Western North Atlantic	1,610,106	64,753	0	1,703,401	64,934	0
Short-finned pilot whale	Northern Gulf of Mexico	8,503	106	0	8,934	108	0
	Western North Atlantic	75,058	5,486	0	79,228	5,495	0
Spinner dolphin	Northern Gulf of Mexico	35,410	1,138	0	37,614	1,150	0
	Western North Atlantic	138,115	18,981	0	145,211	18,998	0
Striped dolphin	Northern Gulf of Mexico	11,391	309	0	11,888	312	0
	Western North Atlantic	431,756	33,425	0	478,001	33,502	0
White-beaked dolphin	Western North Atlantic	202	11	0	210	12	0
Family Phocoenidae (porpoises)							
Harbor porpoise	Gulf of Maine/Bay of Fundy	509,229	63,072	120	557,596	67,085	125
Suborder Pinnipedia							
Family Phocidae (true seals)							
Gray seal	Western North Atlantic	1,744	2,575	9	1,831	2,579	9
Harbor seal	Western North Atlantic	2,827	4,175	14	2,969	4,182	14
Harp seal	Western North Atlantic	17,095	20,858	0	18,128	20,868	0
Hooded seal	Western North Atlantic	1,896	1,885	0	2,033	1,893	0
Order Sirenia							
Family Trichechidae (manatees)							

Table E.4-1: Estimated Marine Mammal Impacts per 5-Year Period from Sonar Testing Activities (continued)

Species	Stock	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designated

PTS: permanent threshold shift; TTS: temporary threshold shift

E.5 Estimated Marine Mammal Impacts from Air Guns Under Navy Training Activities

There are no air gun activities under training, therefore there are no anticipated takes.

E.6 Estimated Marine Mammal Impacts from Air Guns Under Navy Testing Activities

Table E.6-1 provides a summary of the estimated number of marine mammal impacts from exposure to air guns used during Navy testing activities under Alternatives 1 and 2 over the course of a year. Most species and stocks in the Study Area either do not occur in areas where air gun activities take place, or did not result in any estimated impact based on the quantitative analysis.

Table E.6-1: Estimated Marine Mammal Impacts per Year from Air Gun Testing Activities

		Alternative 1 – Minimum				*Alternative 1 – Maximum*				*Alternative 2*			
Species	***Stock***	***Behavioral Response***	***TTS***	***PTS***	***Injury***	***Behavioral Response***	***TTS***	***PTS***	***Injury***	***Behavioral Response***	***TTS***	***PTS***	***Injury***
Family Delphinidae (dolphins)													
Bottlenose dolphin	Western North Atlantic Offshore	1	0	0	0	1	0	0	0	1	0	0	0
Clymene dolphin	Western North Atlantic	1	0	0	0	1	0	0	0	1	0	0	0
Suborder Pinnipedia													
Family Phocidae (true seals)													
Gray seal	Western North Atlantic	1	0	0	0	1	0	0	0	1	0	0	0
Harbor seal	Western North Atlantic	2	0	0	0	2	0	0	0	2	0	0	0

PTS: permanent threshold shift; TTS: temporary threshold shift

E.7 Estimated Marine Mammal Impacts per Five year Period from Air Guns Under Navy Testing Activities

Table E.7-1 provides a summary of the estimated number of marine mammal impacts from exposure to air guns used during Navy testing activities under Alternatives 1 and 2 over the course of five years. Most species or stock in the Study Area either do not occur in areas where air gun activities take place, or did not result in any estimated impact based on quantitative analysis.

Table E.7-1: Estimated Marine Mammal Impacts per 5-Year Period from Air Gun Testing Activities

		Alternative 1 – 5-Year				*Alternative 2 – 5-Year*			
Species	*Stock*	*Behavioral Response*	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
Bottlenose dolphin	Western North Atlantic Offshore	6	0	0	0	6	0	0	0
Clymene dolphin	Western North Atlantic	3	0	0	0	3	0	0	0
Suborder Pinnipedia									
Family Phocidae (true seals)									
Gray seal	Western North Atlantic	6	0	0	0	6	0	0	0
Harbor seal	Western North Atlantic	9	0	0	0	9	0	0	0

PTS: permanent threshold shift; TTS: temporary threshold shift

E.8 Estimated Marine Mammal Impacts from Pile Driving Under Navy Training Activities

Table E.8-1 provides a summary of the estimated number of marine mammal impacts from exposure to pile driving used during Navy training activities under Alternatives 1 and 2 over the course of a year. Pile driving only occurs in the Atlantic regions of the Study Area, therefore species or stocks that occur in the Gulf of Mexico would not be impacted. Most species or stocks in the Study Area either do not occur in areas where pile driving activities take place, or did not result in any estimated impact based on quantitative analysis.

Table E.8-1: Estimated Marine Mammal Impacts per Year from Pile Driving Training Activities

Species	Stock	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
		Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS	Behavioral Response	TTS	PTS
Family Delphinidae (dolphins)										
Atlantic spotted dolphin	Western North Atlantic	16	0	0	16	0	0	16	0	0
Bottlenose dolphin	Northern North Carolina Estuarine System	1	0	0	1	0	0	1	0	0
	Western North Atlantic Northern Migratory Coastal	14	0	0	14	0	0	14	0	0
	Western North Atlantic Southern Migratory Coastal	87	0	0	87	0	0	87	0	0
	Western North Atlantic Offshore	791	0	0	791	0	0	791	0	0

PTS: permanent threshold shift; TTS: temporary threshold shift

E.9 Estimated Marine Mammal Impacts per Five year Period from Pile Driving Under Navy Training Activities

Table E.9-1 provides a summary of the estimated number of marine mammal impacts from exposure to pile driving used during Navy training activities under Alternatives 1 and 2 over the course of five years. Pile driving only occurs in the Atlantic regions of the Study Area, therefore species or stocks that occur in the Gulf of Mexico would not be impacted. Most species or stocks in the Study Area either do not occur in areas where pile driving activities take place, or did not result in any estimated impact based on quantitative analysis.

Table E.9-1: Estimated Marine Mammal Impacts per 5-Year Period from Pile Driving Training Activities

Species	Stock	*Alternative 1 – 5-Year*			*Alternative 2 – 5-Year*		
		Behavioral Response	*TTS*	*PTS*	*Behavioral Response*	*TTS*	*PTS*
Family Delphinidae (dolphins)							
Atlantic spotted dolphin	Western North Atlantic	79	0	0	79	0	0
Bottlenose dolphin	Northern North Carolina Estuarine System	5	0	0	5	0	0
	Western North Atlantic Northern Migratory Coastal	68	0	0	68	0	0
	Western North Atlantic Southern Migratory Coastal	433	0	0	433	0	0
	Western North Atlantic Offshore	3,954	0	0	3,954	0	0

PTS: permanent threshold shift; TTS: temporary threshold shift

E.10 Estimated Marine Mammal Impacts from Pile Driving Under Navy Testing Activities

There are no pile driving activities under testing, therefore there are no anticipated takes.

E.11 Estimated Marine Mammal Impacts from Explosives Under Navy Training Activities

Table E.11-1 provides a summary of the estimated number of marine mammal impacts from exposure to explosives used during Navy training activities under Alternatives 1 and 2 over the course of a year.

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities

Species	Stock	*Alternative 1 – Minimum*				*Alternative 1 – Maximum*				*Alternative 2*			
		Behavioral Response	***TTS***	***PTS***	***Injury***	***Behavioral Response***	***TTS***	***PTS***	***Injury***	***Behavioral Response***	***TTS***	***PTS***	***Injury***
Suborder Mysticeti (baleen whales)													
Family Balaenidae (right whales)													
North Atlantic right whale*	Western North Atlantic	0	7	0	0	0	8	0	0	0	7	0	0
Family Balaenopteridae (roquals)													
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	0	0	0	0	0	0	0	0	0	0	0	0
Bryde's whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	NSD†	0	2	0	0	0	2	0	0	0	2	0	0
Minke whale	Canadian East Coast	0	13	0	0	0	13	0	0	0	13	0	0
Fin whale*	Western North Atlantic	0	32	3	0	0	32	3	0	0	32	3	0
Humpback whale	Gulf of Maine	0	14	1	0	0	14	1	0	0	14	1	0
Sei whale*	Nova Scotia	0	2	0	0	0	2	0	0	0	2	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Suborder Odontoceti (toothed whales)													
Family Physeteridae (sperm whale)													
Sperm whale*	Gulf of Mexico Oceanic	0	0	0	0	0	0	0	0	0	0	0	0
	North Atlantic	2	3	0	0	2	3	0	0	2	3	0	0
Family Kogiidae (sperm whales)													
Dwarf sperm whale	Gulf of Mexico Oceanic	0	1	0	0	0	1	0	0	0	1	0	0
	Western North Atlantic	9	14	3	0	9	14	3	0	9	14	3	0
Pygmy sperm whale	Northern Gulf of Mexico	0	1	0	0	0	1	0	0	0	1	0	0
	Western North Atlantic	9	14	3	0	9	14	3	0	9	14	3	0
Family Ziphiidae (beaked whales)													
Blainville's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	0	1	0	0	0	1	0	0	0	1	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Cuvier's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	2	3	0	0	2	3	0	0	2	3	0	0
Gervais' beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	0	1	0	0	0	1	0	0	0	1	0	0
Northern bottlenose whale	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Sowerby's beaked whale	Western North Atlantic	0	1	0	0	0	1	0	0	0	1	0	0
True's beaked whale	Western North Atlantic	0	1	0	0	0	1	0	0	0	1	0	0
Family Delphinidae (dolphins)													
Atlantic spotted dolphin	Northern Gulf of Mexico	1	5	0	0	1	5	0	0	1	5	0	0
	Western North Atlantic	33	78	8	1	33	78	8	1	33	78	8	1

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Atlantic white-sided dolphin	Western North Atlantic	3	7	0	0	3	7	0	0	3	7	0	0
Bottlenose dolphin	Choctawatchee Bay	0	0	0	0	0	0	0	0	0	0	0	0
	Gulf of Mexico Eastern Coastal	0	0	0	0	0	0	0	0	0	0	0	0
	Gulf of Mexico Northern Coastal	1	3	0	0	1	3	0	0	1	3	0	0
	Gulf of Mexico Western Coastal	1	1	0	0	1	1	0	0	1	1	0	0
	Indian River Lagoon Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Jacksonville Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0	0	0	0	0	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
	Northern Gulf of Mexico Continental Shelf	4	21	2	0	4	22	2	0	4	21	2	0
	Northern Gulf of Mexico Oceanic	2	6	0	0	2	6	0	0	2	6	0	0
	Northern North Carolina Estuarine System	1	0	0	0	1	0	0	0	1	0	0	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	1	1	0	0	1	1	0	0	1	1	0	0
	Western North Atlantic Central Florida Coastal	3	5	0	0	3	5	0	0	3	5	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
	Western North Atlantic Northern Migratory Coastal	11	45	3	0	11	45	3	0	11	45	3	0
	Western North Atlantic Offshore	84	368	27	3	84	369	27	3	84	368	27	3
	Western North Atlantic South Carolina/Georgi a Coastal	3	5	0	0	3	5	0	0	3	5	0	0
	Western North Atlantic Southern Migratory Coastal	10	18	1	0	10	18	1	0	10	18	1	0
Clymene dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	8	20	3	0	8	20	3	0	8	20	3	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	*Alternative 1 – Minimum*				*Alternative 1 – Maximum*				*Alternative 2*			
		Behavioral Response	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
False killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	1	2	0	0	1	2	0	0	1	2	0	0
Fraser's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Long-finned pilot whale	Western North Atlantic	2	4	0	0	2	4	0	0	2	4	0	0
Melon-headed whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	3	12	1	0	3	12	1	0	3	12	1	0
Pantropical spotted dolphin	Northern Gulf of Mexico	0	1	0	0	0	1	0	0	0	1	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	*Alternative 1 – Minimum*				*Alternative 1 – Maximum*				*Alternative 2*			
		Behavioral Response	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
	Western North Atlantic	5	11	2	0	5	11	2	0	5	11	2	0
Pygmy killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	1	1	0	0	1	1	0	0	1	1	0	0
Risso's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	2	4	0	0	2	4	0	0	2	4	0	0
Rough-toothed dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	2	5	0	0	2	5	0	0	2	5	0	0
Short-beaked common dolphin	Western North Atlantic	40	79	12	1	40	79	12	1	40	79	12	1
Short-finned pilot whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	2	5	0	0	2	5	0	0	2	5	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Spinner dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	4	14	1	0	4	14	1	0	4	14	1	0
Striped dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	7	13	3	0	7	13	3	0	7	13	3	0
White-beaked dolphin	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Family Phocoenidae (porpoises)													
Harbor porpoise	Gulf of Maine/Bay of Fundy	106	493	149	0	106	493	149	0	106	493	149	0
Suborder Pinnipedia													
Family Phocidae (true seals)													
Gray seal	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Harbor seal	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Harp seal	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0

Table E.11-1: Estimated Marine Mammal Impacts per year from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Hooded seal	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Order Sirenia													
Family Trichechidae (manatees)													
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designated

PTS: permanent threshold shift; TTS: temporary threshold shift

E.12 Estimated Marine Mammal Impacts per Five year Period from Explosives Under Navy Training Activities

Table E.12-1 provides a summary of the estimated number of marine mammal impacts from exposure to explosives used during Navy training activities under Alternatives 1 and 2 over the course of five years.

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Suborder Mysticeti (baleen whales)									
Family Balaenidae (right whales)									
North Atlantic right whale*	Western North Atlantic	0	38	0	0	0	38	0	0
Family Balaenopteridae (roquals)									
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	0	0	0	0	0	0	0	0
Bryde's whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	NSD†	0	9	0	0	0	9	0	0
Minke whale	Canadian East Coast	0	66	0	0	0	66	0	0
Fin whale*	Western North Atlantic	0	159	13	0	0	159	13	0
Humpback whale	Gulf of Maine	0	69	3	0	0	69	3	0
Sei whale*	Nova Scotia	0	11	0	0	0	11	0	0
Suborder Odontoceti (toothed whales)									
Family Physeteridae (sperm whale)									
Sperm whale*	Gulf of Mexico Oceanic	0	0	0	0	0	0	0	0
	North Atlantic	10	15	0	0	10	15	0	0

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Family Kogiidae (sperm whales)									
Dwarf sperm whale	Gulf of Mexico Oceanic	0	4	0	0	0	4	0	0
	Western North Atlantic	47	70	15	0	47	70	15	0
Pygmy sperm whale	Northern Gulf of Mexico	0	4	0	0	0	4	0	0
	Western North Atlantic	47	70	15	0	47	70	15	0
Family Ziphiidae (beaked whales)									
Blainville's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	0	3	0	0	0	3	0	0
Cuvier's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	8	13	0	0	8	13	0	0
Gervais' beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	0	3	0	0	0	3	0	0
Northern bottlenose whale	Western North Atlantic	0	0	0	0	0	0	0	0
Sowerby's beaked whale	Western North Atlantic	0	3	0	0	0	3	0	0
True's beaked whale	Western North Atlantic	0	3	0	0	0	3	0	0

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Family Delphinidae (dolphins)									
Atlantic spotted dolphin	Northern Gulf of Mexico	5	25	0	0	5	25	0	0
	Western North Atlantic	165	390	42	3	165	390	42	3
Atlantic white-sided dolphin	Western North Atlantic	14	33	0	0	14	33	0	0
Bottlenose dolphin	Choctawatchee Bay	0	0	0	0	0	0	0	0
	Gulf of Mexico Eastern Coastal	0	0	0	0	0	0	0	0
	Gulf of Mexico Northern Coastal	3	15	0	0	3	15	0	0
	Gulf of Mexico Western Coastal	3	4	0	0	3	4	0	0
	Indian River Lagoon Estuarine System	0	0	0	0	0	0	0	0
	Jacksonville Estuarine System	0	0	0	0	0	0	0	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0	0	0
	Northern Gulf of Mexico Continental Shelf	21	109	9	0	21	109	9	0
	Northern Gulf of Mexico Oceanic	10	29	0	0	10	29	0	0

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
	Northern North Carolina Estuarine System	3	0	0	0	3	0	0	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	3	5	0	0	3	5	0	0
	Western North Atlantic Central Florida Coastal	13	27	0	0	13	27	0	0
	Western North Atlantic Northern Migratory Coastal	57	225	16	0	57	225	16	0
	Western North Atlantic Offshore	421	1,842	134	15	421	1,842	134	15
	Western North Atlantic South Carolina/Georgia Coastal	13	27	0	0	13	27	0	0
	Western North Atlantic Southern Migratory Coastal	52	89	7	0	52	89	7	0
Clymene dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	39	100	13	0	39	100	13	0

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
False killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	4	9	0	0	4	9	0	0
Fraser's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	0	0	0
Killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	0	0	0
Long-finned pilot whale	Western North Atlantic	12	21	0	0	12	21	0	0
Melon-headed whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	17	58	3	0	17	58	3	0
Pantropical spotted dolphin	Northern Gulf of Mexico	0	3	0	0	0	3	0	0
	Western North Atlantic	26	56	10	0	26	56	10	0
Pygmy killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	3	5	0	0	3	5	0	0
Risso's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities (continued)

Species	Stock	*Alternative 1 – 5-Year*				*Alternative 2 – 5-Year*			
		Behavioral Response	***TTS***	***PTS***	***Injury***	***Behavioral Response***	***TTS***	***PTS***	***Injury***
	Western North Atlantic	8	19	0	0	8	19	0	0
Rough-toothed dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	8	23	0	0	8	23	0	0
Short-beaked common dolphin	Western North Atlantic	201	396	59	3	201	396	59	3
Short-finned pilot whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	12	23	0	0	12	23	0	0
Spinner dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	22	71	6	0	22	71	6	0
Striped dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	36	66	13	0	36	66	13	0
White-beaked dolphin	Western North Atlantic	0	0	0	0	0	0	0	0
Family Phocoenidae (porpoises)									
Harbor porpoise	Gulf of Maine/Bay of Fundy	528	2,465	744	0	528	2,465	744	0
Suborder Pinnipedia									
Family Phocidae (true seals)									
Gray seal	Western North Atlantic	0	0	0	0	0	0	0	0

Table E.12-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Training Activities (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Harbor seal	Western North Atlantic	0	0	0	0	0	0	0	0
Harp seal	Western North Atlantic	0	0	0	0	0	0	0	0
Hooded seal	Western North Atlantic	0	0	0	0	0	0	0	0
Order Sirenia									
Family Trichechidae (manatees)									
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designation

PTS: permanent threshold shift; TTS: temporary threshold shift

E.13 Estimated Marine Mammal Impacts from Explosives Under Navy Testing Activities (Excluding Ship Shock Trials)

Table E.13-1 provides a summary of the estimated number of marine mammal impacts from exposure to explosives used during Navy testing activities (excluding ship shock trials) under Alternatives 1 and 2 over the course of a year.

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Suborder Mysticeti (baleen whales)													
Family Balaenidae (right whales)													
North Atlantic right whale*	Western North Atlantic	0	9	0	0	0	10	0	0	0	10	0	0
Family Balaenopteridae (roquals)													
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	0	0	0	0	0	0	0	0	0	0	0	0
Bryde's whale	Northern Gulf of Mexico	0	0	0	0	0	1	0	0	0	1	0	0
	NSD[†]	0	1	0	0	0	1	0	0	0	1	0	0
Minke whale	Canadian East Coast	0	12	1	0	0	13	1	0	0	16	1	0
Fin whale*	Western North Atlantic	0	34	1	0	0	38	1	0	0	45	2	0
Humpback whale	Gulf of Maine	0	11	0	0	0	11	0	0	0	12	0	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Sei whale*	Nova Scotia	0	4	0	0	0	5	0	0	0	5	0	0
Suborder Odontoceti (toothed whales)													
Family Physeteridae (sperm whale)													
Sperm whale*	Gulf of Mexico Oceanic	0	0	0	0	0	0	0	0	0	0	0	0
	North Atlantic	2	2	0	0	2	3	0	0	2	3	1	0
Family Kogiidae (sperm whales)													
Dwarf sperm whale	Gulf of Mexico Oceanic	4	10	4	0	4	10	5	0	4	12	6	0
	Western North Atlantic	16	19	6	0	20	23	7	0	20	24	7	0
Pygmy sperm whale	Northern Gulf of Mexico	4	10	4	0	4	10	5	0	4	12	6	0
	Western North Atlantic	16	19	6	0	20	23	7	0	20	24	7	0
Family Ziphiidae (beaked whales)													
Blainville's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	1	1	0	0	1	1	0	0	1	1	0	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Cuvier's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	2	2	0	0	3	3	0	0	3	3	0	0
Gervais' beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	1	1	0	0	1	1	0	0	1	1	0	0
Northern bottlenose whale	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Sowerby's beaked whale	Western North Atlantic	1	1	0	0	1	1	0	0	1	1	0	0
True's beaked whale	Western North Atlantic	1	1	0	0	1	1	0	0	1	1	0	0
Family Delphinidae (dolphins)													
Atlantic spotted dolphin	Northern Gulf of Mexico	25	28	2	0	25	29	2	0	30	34	3	0
	Western North Atlantic	49	57	8	1	63	78	10	1	64	80	11	1

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Atlantic white-sided dolphin	Western North Atlantic	13	11	1	0	14	13	1	0	14	13	1	0
Bottlenose dolphin	Choctawatchee Bay	1	1	0	0	1	1	0	0	1	1	0	0
	Gulf of Mexico Eastern Coastal	0	0	0	0	0	0	0	0	0	0	0	0
	Gulf of Mexico Northern Coastal	12	15	1	0	12	15	1	0	13	16	1	0
	Gulf of Mexico Western Coastal	2	2	0	0	2	2	0	0	2	2	0	0
	Indian River Lagoon Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Jacksonville Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0	0	0	0	0	0	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	*Stock*	*Alternative 1 – Minimum*				*Alternative 1 – Maximum*				*Alternative 2*			
		Behavioral Response	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
	Northern Gulf of Mexico Continental Shelf	88	108	8	0	88	109	8	0	94	114	9	0
	Northern Gulf of Mexico Oceanic	11	13	1	0	11	14	1	0	12	14	1	0
	Northern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic Central Florida Coastal	1	1	0	0	1	1	0	0	1	1	0	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
	Western North Atlantic Northern Migratory Coastal	6	14	2	0	7	15	2	0	7	15	2	0
	Western North Atlantic Offshore	61	111	16	1	68	122	17	1	69	123	18	1
	Western North Atlantic South Carolina/Georgia Coastal	1	1	0	0	1	1	0	0	1	1	0	0
	Western North Atlantic Southern Migratory Coastal	2	2	0	0	2	3	0	0	2	3	0	0
Clymene dolphin	Northern Gulf of Mexico	1	1	0	0	1	1	0	0	1	1	0	0
	Western North Atlantic	11	15	1	0	14	19	2	0	14	20	2	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

		Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
Species	Stock	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
False killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	1	2	0	0	1	2	0	0	1	2	0	0
Fraser's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	1	0	0	0	1	0	0
Killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Long-finned pilot whale	Western North Atlantic	4	4	1	0	4	5	2	0	5	5	2	0
Melon-headed whale	Northern Gulf of Mexico	0	1	0	0	0	1	0	0	0	1	0	0
	Western North Atlantic	4	5	1	0	6	7	1	0	6	7	1	0
Pantropical spotted dolphin	Northern Gulf of Mexico	4	4	1	0	4	5	1	0	4	5	1	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
	Western North Atlantic	17	17	3	0	21	21	4	0	21	21	4	0
Pygmy killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	1	1	0	0	1	1	0	0	1	1	0	0
Risso's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	2	5	1	0	3	6	1	0	3	6	1	0
Rough-toothed dolphin	Northern Gulf of Mexico	2	3	0	0	2	3	0	0	2	3	0	0
	Western North Atlantic	3	3	0	0	3	4	0	0	4	4	0	0
Short-beaked common dolphin	Western North Atlantic	84	99	12	1	100	126	16	1	103	131	17	1
Short-finned pilot whale	Northern Gulf of Mexico	0	1	0	0	0	1	0	0	0	1	0	0
	Western North Atlantic	2	3	1	0	3	4	1	0	3	5	2	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – Minimum				Alternative 1 – Maximum				Alternative 2			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Spinner dolphin	Northern Gulf of Mexico	1	2	0	0	1	3	0	0	3	4	1	0
	Western North Atlantic	11	14	1	0	14	19	2	0	14	19	2	0
Striped dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0	0	0	0	0
	Western North Atlantic	19	19	4	0	23	24	5	0	24	25	5	0
White-beaked dolphin	Western North Atlantic	0	0	0	0	0	0	0	0	0	0	0	0
Family Phocoenidae (porpoises)													
Harbor porpoise	Gulf of Maine/Bay of Fundy	463	654	170	0	503	724	187	0	504	748	213	0
Suborder Pinnipedia													
Family Phocidae (true seals)													
Gray seal	Western North Atlantic	5	5	0	0	6	5	0	0	6	5	0	0
Harbor seal	Western North Atlantic	9	8	1	0	9	8	1	0	9	8	1	0
Harp seal	Western North Atlantic	34	30	2	0	34	30	2	0	34	30	2	0

Table E.13-1: Estimated Marine Mammal Impacts per Year from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	*Stock*	*Alternative 1 – Minimum*				*Alternative 1 – Maximum*				*Alternative 2*			
		Behavioral Response	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
Hooded seal	Western North Atlantic	3	2	0	0	3	2	0	0	3	2	0	0
Order Sirenia													
Family Trichechidae (manatees)													
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designation

PTS: permanent threshold shift; TTS: temporary threshold shift

E.14 Estimated Marine Mammal Impacts per Five Year Period from Explosives Under Navy Testing Activities (Excluding Ship Shock Trials)

Table E.14-1 provides a summary of the estimated number of marine mammal impacts from exposure to explosives used during Navy testing activities (excluding ship shock trials) under Alternatives 1 and 2 over the course of five years.

Table E.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Suborder Mysticeti (baleen whales)									
Family Balaenidae (right whales)									
North Atlantic right whale*	Western North Atlantic	0	48	0	0	0	49	0	0
Family Balaenopteridae (roquals)									
Blue whale*	Western North Atlantic (Gulf of St. Lawrence)	0	0	0	0	0	0	0	0
Bryde's whale	Northern Gulf of Mexico	0	3	0	0	0	5	0	0
	NSD†	0	6	0	0	0	7	0	0
Minke whale	Canadian East Coast	0	63	4	0	0	78	4	0
Fin whale*	Western North Atlantic	0	177	7	0	0	225	9	0
Humpback whale	Gulf of Maine	0	54	0	0	0	60	0	0
Sei whale*	Nova Scotia	0	22	0	0	0	26	0	0
Suborder Odontoceti (toothed whales)									
Family Physeteridae (sperm whale)									
Sperm whale*	Gulf of Mexico Oceanic	0	0	0	0	0	0	0	0
	North Atlantic	9	12	0	0	11	15	3	0
Family Kogiidae (sperm whales)									
Dwarf sperm whale	Gulf of Mexico Oceanic	21	49	22	0	22	61	29	0
	Western North Atlantic	91	106	32	0	98	120	37	0

TableE.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Pygmy sperm whale	Northern Gulf of Mexico	21	49	22	0	22	61	29	0
	Western North Atlantic	91	106	32	0	98	120	37	0
Family Ziphiidae (beaked whales)									
Blainville's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	4	4	0	0	4	4	0	0
Cuvier's beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	13	14	0	0	14	16	0	0
Gervais' beaked whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	4	4	0	0	4	4	0	0
Northern bottlenose whale	Western North Atlantic	0	0	0	0	0	0	0	0
Sowerby's beaked whale	Western North Atlantic	4	4	0	0	4	4	0	0
True's beaked whale	Western North Atlantic	4	4	0	0	4	4	0	0

TableE.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Family Delphinidae (dolphins)									
Atlantic spotted dolphin	Northern Gulf of Mexico	126	141	12	0	152	169	16	0
	Western North Atlantic	287	343	46	4	322	398	53	5
Atlantic white-sided dolphin	Western North Atlantic	67	60	6	0	71	67	6	0
Bottlenose dolphin	Choctawatchee Bay	5	6	0	0	5	6	0	0
	Gulf of Mexico Eastern Coastal	0	0	0	0	0	0	0	0
	Gulf of Mexico Northern Coastal	61	75	5	0	65	79	6	0
	Gulf of Mexico Western Coastal	12	10	0	0	12	11	0	0
	Indian River Lagoon Estuarine System	0	0	0	0	0	0	0	0
	Jacksonville Estuarine System	0	0	0	0	0	0	0	0
	Mississippi Sound, Lake Borgne, Bay Boudreau	0	0	0	0	0	0	0	0
	Northern Gulf of Mexico Continental Shelf	442	544	39	0	469	572	45	0
	Northern Gulf of Mexico Oceanic	56	68	5	0	59	71	6	0
	Northern North Carolina Estuarine System	0	0	0	0	0	0	0	0

TableE.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	*Stock*	*Alternative 1 – 5-Year*				*Alternative 2 – 5-Year*			
		Behavioral Response	*TTS*	*PTS*	*Injury*	*Behavioral Response*	*TTS*	*PTS*	*Injury*
	Southern North Carolina Estuarine System	0	0	0	0	0	0	0	0
	Western North Atlantic Northern Florida Coastal	0	0	0	0	0	0	0	0
	Western North Atlantic Central Florida Coastal	6	6	0	0	6	6	0	0
	Western North Atlantic Northern Migratory Coastal	33	71	11	0	35	75	12	0
	Western North Atlantic Offshore	323	583	84	5	344	616	88	5
	Western North Atlantic South Carolina/Georgia Coastal	6	6	0	0	6	6	0	0
	Western North Atlantic Southern Migratory Coastal	11	11	0	0	12	13	0	0
Clymene dolphin	Northern Gulf of Mexico	4	3	0	0	4	4	0	0
	Western North Atlantic	63	87	7	0	70	98	9	0
False killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	5	10	0	0	6	12	0	0

TableE.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Fraser's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	0	3	0	0	0	4	0	0
Killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	0	0	0	0	0	0	0	0
Long-finned pilot whale	Western North Atlantic	20	23	6	0	24	27	8	0
Melon-headed whale	Northern Gulf of Mexico	0	3	0	0	0	3	0	0
	Western North Atlantic	25	32	4	0	29	37	4	0
Pantropical spotted dolphin	Northern Gulf of Mexico	19	23	4	0	22	26	5	0
	Western North Atlantic	96	95	17	0	106	107	19	0
Pygmy killer whale	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	3	6	0	0	4	7	0	0
Risso's dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	14	27	6	0	16	32	7	0
Rough-toothed dolphin	Northern Gulf of Mexico	11	14	0	0	11	15	0	0
	Western North Atlantic	16	18	0	0	18	21	0	0

TableE.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Short-beaked common dolphin	Western North Atlantic	463	563	68	3	516	657	86	5
Short-finned pilot whale	Northern Gulf of Mexico	0	4	0	0	0	4	0	0
	Western North Atlantic	12	20	6	0	14	23	8	0
Spinner dolphin	Northern Gulf of Mexico	6	13	0	0	13	20	3	0
	Western North Atlantic	63	82	7	0	70	94	8	0
Striped dolphin	Northern Gulf of Mexico	0	0	0	0	0	0	0	0
	Western North Atlantic	104	107	21	0	121	124	25	0
White-beaked dolphin	Western North Atlantic	0	0	0	0	0	0	0	0
Family Phocoenidae (porpoises)									
Harbor porpoise	Gulf of Maine/Bay of Fundy	2,411	3,417	887	0	2,520	3,739	1,064	0
Suborder Pinnipedia									
Family Phocidae (true seals)									
Gray seal	Western North Atlantic	27	24	0	0	28	24	0	0
Harbor seal	Western North Atlantic	44	39	3	0	45	39	3	0
Harp seal	Western North Atlantic	170	150	11	0	172	151	11	0
Hooded seal	Western North Atlantic	13	11	0	0	13	11	0	0

TableE.14-1: Estimated Marine Mammal Impacts per 5-Year Period from Explosive Testing Activities (Excluding Ship Shock Trials) (continued)

Species	Stock	Alternative 1 – 5-Year				Alternative 2 – 5-Year			
		Behavioral Response	TTS	PTS	Injury	Behavioral Response	TTS	PTS	Injury
Order Sirenia									
Family Trichechidae (manatees)									
West Indian manatee*	Florida, Antillean	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

†NSD: No stock designation

PTS: permanent threshold shift; TTS: temporary threshold shift

E.15 Estimated Marine Mammal Impacts from Ship Shock Trials Under Navy Testing Activities

Table E.15-1 provides a summary of the estimated number of marine mammal impacts from exposure to Navy ship shock trials (an explosive testing activity) under Alternatives 1 and 2 from small and large shock trials, and over the course of five years. The small ship shock trial could take place up to 3 times over a five-year period and the large ship shock trial could take place once. Takes per species below are the maximum for any proposed location and season. Stock designations are not provided since they are highly dependent on the actual location chosen for each shock trial. See Chapter 2 (Description of Proposed Action and Alternatives) for details on locations and seasons for ship shock trials.

Table E.15-1: Estimated Marine Mammal Impacts from Small and Large Ship Shock Trials (Explosive Testing Activity) and per 5-Year Period

Species	Small Ship Shock				Large Ship Shock				5-Year Total			
	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality
Suborder Mysticeti (baleen whales)												
Family Balaenidae (right whales)												
North Atlantic right whale*	1	0	0	0	2	0	0	0	5	0	0	0
Family Balaenopteridae (roquals)												
Blue whale*	0	0	0	0	1	0	0	0	1	0	0	0
Bryde's whale	3	0	0	0	6	1	0	0	15	1	0	0
Minke whale	19	1	0	0	39	3	0	0	96	6	0	0
Fin whale*	131	3	0	0	234	27	0	0	627	36	0	0
Humpback whale	8	0	0	0	20	2	0	0	44	2	0	0
Sei whale*	12	1	0	0	27	4	0	0	63	7	0	0
Suborder Odontoceti (toothed whales)												
Family Physeteridae (sperm whale)												
Sperm whale*	1	1	0	0	3	3	1	0	6	6	1	0
Family Kogiidae (sperm whales)												
Dwarf sperm whale	46	28	0	0	91	70	0	0	229	154	0	0
Pygmy sperm whale	46	28	0	0	91	70	0	0	229	154	0	0
Family Ziphiidae (beaked whales)												
Blainville's beaked whale	1	0	0	0	1	1	0	0	4	1	0	0
Cuvier's beaked whale	2	1	0	0	2	3	0	0	8	6	0	0
Gervais' beaked whale	1	0	0	0	1	1	0	0	4	1	0	0
Northern bottlenose whale	0	0	0	0	0	0	0	0	0	0	0	0
Sowersby's beaked whale	1	0	0	0	1	1	0	0	4	1	0	0
True's beaked whale	1	0	0	0	1	1	0	0	4	1	0	0

Table E.15-1: Estimated Marine Mammal Impacts from Small and Large Ship Shock Trials (Explosive Testing Activity) and per 5-Year Period (continued)

Species	Small Ship Shock				Large Ship Shock				5-Year Total			
	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality
Family Delphinidae (dolphins)												
Atlantic spotted dolphin	6	3	1	0	8	8	4	0	26	17	7	0
Atlantic white-sided dolphin	1	1	0	0	3	6	3	1	6	9	3	1
Bottlenose dolphin	13	8	2	0	16	19	5	0	55	43	11	0
Clymene dolphin	2	4	1	0	9	5	3	0	15	17	6	0
False killer whale	0	0	0	0	2	1	0	0	2	1	0	0
Fraser's dolphin	0	0	0	0	2	2	1	0	2	2	1	0
Killer whale	0	0	0	0	0	0	0	0	0	0	0	0
Long-finned pilot whale	2	2	0	0	5	5	1	0	11	11	1	0
Melon-headed whale	1	1	0	0	5	3	1	0	8	6	1	0
Pantropical spotted dolphin	2	2	1	0	25	14	6	1	31	20	9	1
Pygmy killer whale	0	0	0	0	1	1	0	0	1	1	0	0
Risso's dolphin	1	1	0	0	3	1	0	0	6	4	0	0
Rough-toothed dolphin	1	0	0	0	3	1	1	0	6	1	1	0
Short-beaked common dolphin	40	40	11	1	67	73	34	3	187	193	67	6
Short-finned pilot whale	2	2	0	0	4	4	1	0	10	10	1	0
Spinner dolphin	3	1	0	0	37	31	14	1	46	34	14	1
Striped dolphin	4	6	2	0	10	8	4	0	22	26	10	0
White-beaked dolphin	0	0	0	0	0	0	0	0	0	0	0	0
Family Phocoenidae (porpoises)												
Harbor porpoise	43	41	0	0	120	81	0	0	249	204	0	0
Suborder Pinnipedia												
Family Phocidae (true seals)												
Gray seal	0	0	0	0	0	0	0	0	0	0	0	0
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0

Table E.15-1: Estimated Marine Mammal Impacts from Small and Large Ship Shock Trials (Explosive Testing Activity) and per 5-Year Period (continued)

Species	Small Ship Shock				Large Ship Shock				5-Year Total			
	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality
Harp seal	0	0	0	0	0	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0	0	0	0	0	0
Order Sirenia												
Family Trichechidae (manatees)												
West Indian manatee*	0	0	0	0	0	0	0	0	0	0	0	0

* ESA-listed species (all stocks) within the AFTT Study Area

PTS: permanent threshold shift; TTS: temporary threshold shift

E.16 Estimated Sea Turtle Impacts from Sonar and Other Transducers During Navy Training and Testing Activities

Table E.16-1 provides a summary of the estimated number of sea turtle impacts from exposure to sonar and other transducers used during Navy training and testing activities under Alternatives 1 and 2 over the course of a year.

Table E.16-1: Estimated Sea Turtle Impacts per Year from Sonar Training and Testing Activities

Species	*Alternative 1 – Minimum*		*Alternative 1 – Maximum*		*Alternative 2*	
	TTS	*PTS*	*TTS*	*PTS*	*TTS*	*PTS*
Sonar Training Activities						
Family Cheloniidae (hardshell turtles)						
Green turtle*	0	0	0	0	0	0
Hawksbill turtle*	0	0	0	0	0	0
Kemp's ridley turtle*	0	0	0	0	0	0
Loggerhead turtle*	0	0	0	0	0	0
Family Dermochelyidae (scuteless turtles)						
Leatherback turtle*	0	0	0	0	0	0
Sonar Testing Activities						
Family Cheloniidae (hardshell turtles)						
Green turtle*	0	0	0	0	0	0
Hawksbill turtle*	0	0	0	0	0	0
Kemp's ridley turtle*	1	0	1	0	1	0
Loggerhead turtle*	6	0	6	0	6	0
Family Dermochelyidae (scuteless turtles)						
Leatherback turtle*	1	0	1	0	1	0

* ESA-listed species within the AFTT Study Area

PTS: permanent threshold shift; TTS: temporary threshold shift

E.17 Estimated Sea Turtle Impacts per Five Year Period from Sonar and Other Transducers Under Navy Training and Testing Activities

Table E.17-1 provides a summary of the estimated number of sea turtle impacts from exposure to sonar and other transducers used during Navy training and testing activities under Alternatives 1 and 2 over the course of five years.

Table E.17-1: Estimated Sea Turtle Impacts per 5-Year Period from Sonar Training and Testing Activities

Species	*Alternative 1 – 5-Year*		*Alternative 2 – 5-Year*	
	TTS	***PTS***	***TTS***	***PTS***
Sonar Training Activities				
Family Cheloniidae (hardshell turtles)				
Green turtle*	0	0	0	0
Hawksbill turtle*	0	0	0	0
Kemp's ridley turtle*	0	0	0	0
Loggerhead turtle*	0	0	0	0
Family Dermochelyidae (scuteless turtles)				
Leatherback turtle*	0	0	0	0
Sonar Testing Activities				
Family Cheloniidae (hardshell turtles)				
Green turtle*	0	0	0	0
Hawksbill turtle*	0	0	0	0
Kemp's ridley turtle*	3	0	3	0
Loggerhead turtle*	32	0	32	0
Family Dermochelyidae (scuteless turtles)				
Leatherback turtle*	3	0	3	0

* ESA-listed species within the AFTT Study Area

PTS: permanent threshold shift; TTS: temporary threshold shift

E.18 Estimated Sea Turtle Impacts from Air Guns Under Navy Training and Testing Activities

There are no air gun activities under training, therefore there are no anticipated takes. No sea turtle impacts are anticipated from exposure to air guns used during Navy testing activities under Alternatives 1 and 2 over the course of a year and over the course of five years.

E.19 Estimated Sea Turtle Impacts from Pile Driving Under Navy Training and Testing Activities

No sea turtle impacts are anticipated from exposure to pile driving used during Navy testing activities under Alternatives 1 and 2 over the course of a year and over the course of five years. There are no pile driving activities under testing, therefore there are no anticipated takes.

E.20 Estimated Sea Turtle Impacts from Explosives Under Navy Training and Testing Activities

Table E.20-1 provides a summary of the estimated number of sea turtle impacts from exposure to explosives used during Navy training and testing activities, excluding ship shock trials, under Alternatives 1 and 2 over the course of a year.

Table E.20-1: Estimated Sea Turtle Impacts per Year from Explosive Training and Testing Activities

Species	Alternative 1 – Minimum			Alternative 1 – Maximum			Alternative 2		
	TTS	PTS	Injury	TTS	PTS	Injury	TTS	PTS	Injury
Explosive Training Activities									
Family Cheloniidae (hardshell turtles)									
Green turtle*	2	1	0	2	1	0	2	1	0
Hawksbill turtle*	0	0	0	0	0	0	0	0	0
Kemp's ridley turtle*	3	2	0	3	2	0	3	2	0
Loggerhead turtle*	57	26	4	57	26	4	57	26	4
Family Dermochelyidae (scuteless turtles)									
Leatherback turtle*	5	2	0	5	2	0	5	2	0
Explosive Testing Activities (Excluding Ship Shock Trials)									
Family Cheloniidae (hardshell turtles)									
Green turtle*	2	1	0	2	2	0	3	2	0
Hawksbill turtle*	0	0	0	0	0	0	0	0	0
Kemp's ridley turtle*	3	1	0	4	1	0	4	2	0
Loggerhead turtle*	26	12	2	29	15	3	34	16	3
Family Dermochelyidae (scuteless turtles)									
Leatherback turtle*	3	1	0	4	1	0	4	1	0

* ESA-listed species within the AFTT Study Area

PTS: permanent threshold shift; TTS: temporary threshold shift

E.21 Estimated Sea Turtle Impacts per Five year Period from Explosives Under Navy Training and Testing Activities

Table E.21-1 provides a summary of the estimated number of sea turtle impacts from exposure to explosives used during Navy training and testing activities, excluding ship shock trials, under Alternatives 1 and 2 per five year period.

Table E.21-1: Estimated Sea Turtle Impacts per 5-Year Period from Explosive Training and Testing Activities (Excluding Ship Shock Trials)

Species	Alternative 1 – 5-Year			Alternative 2 – 5-Year		
	TTS	PTS	Injury	TTS	PTS	Injury
Explosive Training Activities						
Family Cheloniidae (hardshell turtles)						
Green turtle*	12	5	0	12	5	0
Hawksbill turtle*	0	0	0	0	0	0
Kemp's ridley turtle*	17	12	0	17	12	0
Loggerhead turtle*	287	131	18	287	131	18
Family Dermochelyidae (scuteless turtles)						
Leatherback turtle*	23	10	0	23	10	0
Explosive Testing Activities (Excluding Ship Shock Trials)						
Family Cheloniidae (hardshell turtles)						
Green turtle*	12	8	0	13	8	0
Hawksbill turtle*	0	0	0	0	0	0
Kemp's ridley turtle*	16	6	0	22	8	0
Loggerhead turtle*	135	67	12	171	82	14
Family Dermochelyidae (scuteless turtles)						
Leatherback turtle*	18	4	0	21	6	0

* ESA-listed species within the AFTT Study Area

PTS: permanent threshold shift; TTS: temporary threshold shift

E.22 Estimated Sea Turtle Impacts from Ship Shock Trials Under Navy Testing Activities

Table E.22-1 provides a summary of the estimated number of sea turtle impacts from exposure to Navy ship shock trials (an explosive testing activity) under Alternatives 1 and 2 from small and large shock trials, and over the course of five years. The small ship shock trial could take place up to 3 times over a five-year period and the large ship shock trial could take place once. Takes per species below are the maximum for any proposed location and season. See Chapter 2 (Description of Proposed Action and Alternatives) for details on locations and seasons for ship shock trials.

Table E.22-1: Estimated Sea Turtle Impacts from Small and Large Ship Shock Trials (Explosive Testing Activity) and per 5-Year Period

Species	Small Ship Shock				Large Ship Shock				5-Year Total			
	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality	TTS	PTS	Injury	Mortality
Family Cheloniidae (hardshell turtles)												
Green turtle*	18	1	0	0	18	1	0	0	72	4	0	0
Hawksbill turtle*	2	0	0	0	2	0	0	0	8	0	0	0
Kemp's ridley turtle*	12	1	0	0	15	1	1	0	51	4	1	0
Loggerhead turtle*	339	19	5	1	283	13	4	1	1,300	70	19	4
Family Dermochelyidae (scuteless turtles)												
Leatherback turtle*	169	7	1	0	215	7	2	0	722	28	5	0

* ESA-listed species within the AFTT Study Area

PTS: permanent threshold shift; TTS: temporary threshold shift

References

U.S. Department of the Navy. (2018). *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (Technical Report prepared by NUWC Division Newport, Space and Naval Warfare Systems Center Pacific, G2 Software Systems, and the National Marine Mammal Foundation). Newport, RI: Naval Undersea Warfare Center.

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APPENDIX F
Military Expended Materials and Direct Strike Impact Analyses

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Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

This section does not contain figures.

List of Tables

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APPENDIX F MILITARY EXPENDED MATERIAL AND DIRECT STRIKE IMPACT ANALYSIS

F.1 ESTIMATING THE IMPACT OF MILITARY EXPENDED MATERIALS AND IN-WATER EXPLOSIONS ON ABIOTIC SUBSTRATES AS A HABITAT FOR BIOLOGICAL RESOURCES

This section discusses the methods and results for quantifying two scenarios under Alternative 1 and Alternative 2 of the Proposed Action: (1) the highly improbable worst-case scenario of all military expended materials or in-water explosions occurring on one particular substrate type, and (2) the unlikely, but slightly more realistic, scenario of uniform or proportional impact distribution within a particular area. Training and testing typically occurs in areas that are not called out or linked to specific activities for various reasons (e.g., flexibility and national security). Because training and testing activities would not be conducted under the No Action Alternative, it will not be discussed in this appendix.

This section describes the calculation of the disturbance footprint (i.e., military expended material footprint or explosive crater footprint) of an instantaneous impact of military expended materials or explosions on the substrate. The actual instantaneous impact on the bottom will depend on the number and location of military expended materials expended and not recovered, which is likely much lower and more concentrated than either scenario being analyzed. Longer term impacts on the bottom are far more difficult to quantify – refer to Section 3.5 (Habitats) for qualitative discussion.

The analysis requires two data elements: (1) a tabular summary of the military expended material or crater (in-water explosions) footprints expected in training and testing areas, and (2) a tabular summary of analysis dimensions, which includes abiotic substrate areas. The data for (1) comes from the Atlantic Fleet Training and Testing (AFTT) action proponents and represents the most locational flexibility with regard to expenditure of military expended materials and in-water explosions. The data for both expended and recovered material is reported in Table F-1 through Table F-17. Appendix A (Navy Activity Descriptions) of the AFTT Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) provides basic descriptions of military expended materials and Section 3.0.3.3.2 (Explosive Stressors) provides basic descriptions of explosive categories. The data for number of military expended materials and in-water explosions are then multiplied by an estimate of the footprint size documented in Table F-1. The data for (2) comes from a compilation of abiotic substrate mapping presented in Section 3.5 (Habitats).

To determine the potential level of disturbance of military expended materials on marine substrates, it was assumed that the impact footprint of the expended material on the seafloor is twice the size of its footprint (unless specified otherwise in the notes for Table F-1 through Table F-38). By doubling the footprint, the results should more accurately reflect the potential disturbance to soft bottom habitats (i.e., to account for sediment plumes), but should overestimate disturbance to hard bottom habitats (i.e., because sediment plumes are not expected) based on mitigation requirements. Items with casings (e.g., small-, medium-, and large-caliber munitions; flares; sonobuoys; etc.) have their impact footprints further doubled to account for both the item and its casing. To be conservative, items and their casings were assumed to be the same size, although in reality the items are a smaller size in order to fit in their casing.

Table F-1: Categories and Footprints for Various Materials and In-Water Explosions

Material Group	*Material Category*	*Bottom Frequency**	*Crater Footprint (ft.^{2})*	*MEM Size (ft.^{2})*	*MEM Footprint (ft.^{2})*	*Material Specific Notes*
Bomb	Bombs (Explosive)	NA	NA	8.1203	112.9048	The MEM footprint was calculated using the bomb with the largest footprint in terms of material fragments, which in this case is the Rockeye which disperses 247 bomblets.
	Bombs (Non-explosive)	NA	NA	8.1203	112.9048	
Countermeasure	Acoustic Countermeasures	NA	NA	0.31107	1.2432	Includes all type of non-recoverable Acoustic Countermeasures
	Chaff- Air Cartridge	NA	NA	0.0012	0.0022	Chaff is a radar reflector material made of thin, narrow, metallic strips cut in various lengths to elicit frequency responses, which deceive enemy radars. Chaff-Air is fired from an aircraft using a small cartridge.
	Chaff-Ship Cartridge	NA	NA	2.000	4.000	Chaff-ship serves the same purpose of chaff-air. It is fired from a ship in cartridges.
	Anti-torpedo Torpedo	NA	NA	4.5424	9.0847	The Countermeasure Anti-torpedo consists of an anti-torpedo torpedo enclosed within All Up Round Equipment canister. The anti-torpedo torpedo is a 6.75-inch diameter high-maneuverability hard-kill torpedo designed to rapidly intercept and engage an incoming threat torpedo. The All Up Round Equipment consists of a nose sabot, ram plate, launch tube, muzzle cover, and breech mechanism to encapsulate, protect, and ultimately launch the anti-torpedo torpedo. Anti-torpedo torpedo s are frequently recovered; assume all are non-recoverable for worst-case.
	Flares	NA	NA	1.2196	4.8782	Assumed to not have parachutes
Explosive Charge	0.5 lb. HE charges	50%	12	NA	NA	None
	10 lb. HE charges	50%	85	NA	NA	None
	20 lb. HE charges	50%	135	NA	NA	None
	5 lb. HE charges	50%	54	NA	NA	None
	60 lb. HE charges	50%	281	NA	NA	None
	650 lb. HE charges	50%	14800.3763	25.7903	51.5806	Another name for an explosive mine including material based on the footprint of a mine shape.
	Line Charges	100%	4324	NA	NA	None

Table F-1: Categories and Footprints for Various Materials and In-water Explosions (continued)

Material Group	*Material Category*	*Bottom Frequency**	*Crater Footprint (ft^2)*	*MEM Size (ft^2)*	*MEM Footprint (ft^2)*	*Material Specific Notes*
Missiles	Missiles (Explosive)	NA	NA	37.3669	74.7338	MEM size based on SM-6
	Missile (Non-explosive)	NA	NA	14.1771	28.3543	MEM size based on Harpoon
	Rockets (Explosive)	NA	NA	0.7987	1.5974	MEM sized based on Hydra 70
	Rockets (Non-explosive)	NA	NA	0.7987	1.5974	MEM size based on Hydra 70. Also include flechette rockets.
	Rockets (Non-explosive): Flechette	NA	NA	0.7987	1.5974	MEM size based on Hydra 70. Included flechette darts in warhead.
Other	Air-launched lightweight (Explosive) torpedo	NA	NA	19.1199	38.2399	MEM size based on MK50/MK54
	Air-launched lightweight (Non-explosive) torpedo	NA	NA	19.1199	38.2399	MEM size based on MK50/MK54. Typically recovered
	AMNS/EMNS Neutralizer (Explosive)	50%	430.5564	1.6286	3.2572	AMNS is air deployed whereas EMNS is ship deployed
	Anti- torpedo Torpedo Accessories	**NA**	NA	1.0107	2.0215	MEM includes ballast weights, flex tubing (parachute size not included)
	Anchor - Other	NA	NA	3.1248	6.2495	Sand bags, concrete blocks, or weights, typically associated with equipment recovered using an acoustic release (anchor remains). This does not include anchors use for mine shapes.
	Anchor -Mine	NA	NA	6.2495	12.5001	Associated primarily with mine shapes.
	Biodegradable Polymer	NA	NA	NA	NA	A substance composed of molecules that degrade as a result of microorganisms and/or enzymes. Footprint is not applicable because the material breaks up within a couple of hours, depending on the type of material out of which the polymer is made. Reference: Karlsson and Albertsson. 1998. Biodegradable polymers and environmental interaction. Polymer Engineering and Science 38(8): 1251-1253.
	Bottom Placed	NA	NA	2.0000	4.000	Likely moored tracking beacons, so the footprint on the

Table F-1: Categories and Footprints for Various Materials and In-water Explosions (continued)

Material Group	*Material Category*	*Bottom Frequency**	*Crater Footprint (ft^2)*	*MEM Size (ft^2)*	*MEM Footprint (ft^2)*	*Material Specific Notes*
	Instruments					bottom would be approximately 2 square feet. It would weight approximately 50 pounds.
	Buoy (Explosive)	NA	NA	0.9752	3.8987	Explosive buoys including mini-sound source and SUS. MEM-size based on Marine Marker.
	Buoy (Non-explosive)	NA	NA	0.9752	3.8987	These buoys are separate from sonobuoys, and are included for DWADS (expendable) or IMPASS (recovered). MEM size based on Marine Marker. Can be expended or recovered.
	Canister-Miscellaneous	NA	NA	2.0000	4.0000	The specific description is classified. Applies only to where it cannot be associated to another object (e.g., canister associated with chaff would be covered by 'chaff')
	Compression Pad or Plastic Piston	NA	NA	0.0043	0.0086	Assumed similar 2-dimensional footprint as endcaps and pistons, but made of floating material
	Concrete slugs	NA	NA	0.0011	0.0022	Assume similar in dimensions to a chaff cartridge
	Endcaps & Pistons – Non Chaff & Flare	NA	NA	0.0043	0.0086	Applies only to where it cannot be associated to another object (e.g., endcaps and pistons associated with chaff would be covered by 'chaff'). Used for testing.
	Endcaps –Chaff & Flare	NA	NA	0.00215	0.0043	Applies only to Chaff-Air and Flares. 1 Endcap is expended per chaff-air or flare.
	Flare O-Ring	NA	NA	0.0043	0.0086	Assumed similar 2-dimensional footprint as endcaps and pistons. Associated with flares. Assumed 1 Flare O-Ring per flare.
	Fiber Optic Can	NA	NA	0.0011	0.0022	Assumed similar 2-dimensional footprint as chaff-air cartridge. Associated with AMNS Neutralizer fiber optic cable. Can that holds fiber optic cable is expended.
	Expended Bathythermograph	NA	NA	0.0258	0.0516	An instrument that is deployed from a ship to record temperature and depth measurements. Small wires transmit the temperature data from the probe to the ship. This item is fairly standard in terms of footprint; these are off the shelf Commercial products. Reference: NOAA 2015.

Table F-1: Categories and Footprints for Various Materials and In-water Explosions (continued)

Material Group	*Material Category*	*Bottom Frequency**	*Crater Footprint (ft^2)*	*MEM Size (ft^2)*	*MEM Footprint (ft^2)*	*Material Specific Notes*
						http://www.aoml.noaa.gov/goos/uot/xbt-what-is.php. Accessed November 3, 2015.
	Fiber optic cables	NA	NA	NA	NA	Associated with some rockets and AMNS neutralizers
	Guidance wires	NA	NA	0	0	Fragments created for relatively small portion associated with explosive devices (associated with heavyweight torpedoes).
	Expended Bathythermograph Wire	NA	NA	NA	NA	Single vertical wire
	Heavyweight (Explosive) torpedo	NA	NA	39.6155	79.2299	MEM size based on MK-48
	Heavyweight torpedo accessories	NA	NA	0.1615	3.2367	MEM includes ballast weights, flex tubing
	Heavyweight (Non-explosive) torpedo	NA	NA	NA	NA	Typically recovered
	Illumination flares	NA	NA	1.2196	4.8782	Flares that have a large parachute; MEM size based on half the surface area of an 18 ft diameter parachute used with an LUU-2 illumination flare.
	Lightweight Torpedo Accessories	NA	NA	1.0107	2.0215	MEM includes ballast weights, flex tubing (parachute size not included)
	Marine marker	NA	NA	0.9752	3.8987	MEM footprint based on two Navy marine markers (MK25 and MK58
	Mine (Explosive)	50%	14800.376	25.7903	51.5806	Another name for a 650 lb. HE explosive charge including material based on the footprint of a mine shape.
	Decelerator/Parachute – Extra Large	NA	NA	5,026.50	10,053.09	MEM size based on diameter of Air Target- Drone parachute (BQM 34S [80-ft in diameter])
	Decelerator/Parachute - Large	NA	NA	1,963.50	3,926.90	
	Decelerator/Parachute	NA	NA	254.5	508.9	MEM size based on diameter of LUU-2 illumination flare

Table F-1: Categories and Footprints for Various Materials and In-water Explosions (continued)

Material Group	*Material Category*	*Bottom Frequency*[*]	*Crater Footprint (ft^2)*	*MEM Size (ft^2)*	*MEM Footprint (ft^2)*	*Material Specific Notes*
	- Medium					parachute (18 ft. diameter).
	Decelerator/Parachute - Small	NA	NA	9.0417	18.0834	Associated with launched sonobuoys and air-launched torpedoes.
	Sabot	NA	NA	1.2195	4.8782	An accessory used during projectile firing. Footprint similar in size to the projectile.
	Sonobuoys (Non-explosive)	NA	NA	1.2206	2.4413	Sonobuoys have an extra item footprint (half the dimensions of the sonobuoy) added in addition to the actual sonobuoy and casing to account for the items that are discarded from the sonobuoy following its release. MEM size does not include the associated Small Decelerator/Parachute (noted in table above)
	Sonobuoys (Explosive)	0	NA	1.2206	2.4413	
	Sonobuoy wires	NA	NA	NA	NA	One wire is associated with each sonobuoy
	Surface-Launched Lightweight (Explosive) Torpedo	0	NA	10.0782	20.1576	MEM size based on MK50/MK54
	Surface-Launched Lightweight (Non-Explosive) Torpedo	NA	NA	10.0782	20.1576	Typically recovered
Projectile	Grenades (Explosive)	0	NA	0.1044	0.2088	None
	Large Caliber (Explosive)	NA	NA	1.0097	4.0386	Item assumed to have a projectile and casing
	Large Caliber (Non-explosive)	NA	NA	1.0097	4.0386	Item assumed to have a projectile and casing
	Large caliber (Casing only)	NA	NA	0.5048	1.0097	Used when the target is on land; no MEM from projectile
	Medium Caliber (Explosive)	NA	NA	0.0560	0.2239	Item assumed to have a projectile and casing
	Medium Caliber (Non-explosive)	NA	NA	0.0560	0.2239	Item assumed to have a projectile and casing

Table F-1: Categories and Footprints for Various Materials and In-water Explosions (continued)

Material Group	*Material Category*	*Bottom Frequency**	*Crater Footprint (ft^2)*	*MEM Size (ft^2)*	*MEM Footprint (ft^2)*	*Material Specific Notes*
	Small Caliber (Non-explosive)	NA	NA	0.0301	0.1216	Item assumed to have a projectile and casing
	Small Caliber (Casing only)	NA	NA	0.0151	0.0301	Used only for small caliber 'blanks'. All other small caliber rounds are included under NEPM
	JATO bottles	NA	NA	3.60607	7.2134	MEM size: Length: 30.6"; Diameter: 5". Infor provided by USFF
	Kinetic Energy Round	NA	NA	0.5048	1.0097	Item assumed to only have a projectile (no casing) - size of Large Caliber round.
Target	Air Target – Drone	NA	NA	95.64	191.28	MEM when specifically known it is an aerial drone; MEM size based on Firebee (BQM-34). Can be expended or recovered
	Air Target – Decoy	NA	NA	14.0216	28.0432	MEM when specifically known it is an air launched decoy. MEM size based on dimensions of Tactical Air Launched Decoy or Miniature Air-Launched Decoy. Can be expended or recovered
	Metal Plates	NA	NA	2.7782	5.5563	Charges are secured to a 20" X 20" X 1/2" ferrous metal plate The target unit (concrete blocks, metal plate, and any debris) is brought to the surface and analyzed.
	Surface Target (Mobile)	NA	NA	5.7522	11.5034	Includes remote controlled or towed targets. Can be expended or recovered
	Surface Target (Stationary)	NA	NA	96.8752	193.7504	MEM when specifically known it is a stationary surface target. MEM size based on Killer Tomato. Can be expended or recovered
	Subsurface Target (Mobile)	NA	NA	1.2206	2.4412	MEM when specifically known it is a sub-surface Motorized Autonomous Target. Can be expended or recovered
	Subsurface Target (Stationary)	NA	NA	5.7522	11.5034	MEM when specifically known it is a sub-surface and stationary. Can be expended or recovered
	Mine Shape (Non-explosive)	NA	NA	25.7903	51.5807	Mine shapes that were specifically identified as non-recoverable; Footprint based on size of explosive mine; size not including anchor. Can be expended or recovered

Table F-1: Categories and Footprints for Various Materials and In-water Explosions (continued)

Material Group	*Material Category*	*Bottom Frequency**	*Crater Footprint (ft^2)*	*MEM Size (ft^2)*	*MEM Footprint (ft^2)*	*Material Specific Notes*
	Mine Shape – (Explosive)	NA	NA	25.7903	51.5807	Another name for a 650 lb HE explosive charge including material based on the footprint of a mine shape. The vast majority of practice mines have built-in anchors for placing on the bottom; relatively few are moored/floating, and none are drifting.
	Ship Hulk	NA	NA	316136.03 67	632272.0 734	None.

Note: * Bottom frequencies (%) are only listed for in-water explosions; crater footprints are only listed for material that may be detonated on the bottom.
MEM = Military Expended Materials; AMNS/EMNS = Airborne Mine Neutralization System/ Expendable Mine Neutralization System; lb. = pound; HE = High Explosive

Additionally, highly explosive munitions that explode either at the surface or in the water column were treated in the same manner as non-explosive practice munitions, although in reality, the explosions would result in smaller fragments reaching the substrate than expected by the fully intact non-explosive practice munitions.

The data for analysis dimensions (data element 2) comes from the Aquatic Habitat Database technical report and supporting databases (U.S. Department of the Navy, 2018a), in addition to spatial data depicting training and testing areas.

The combined analysis dimensions data was used to create a table of substrate category acreage by training and testing areas, and large marine ecosystems. Within the AFTT Study Area, there are acreages of substrate that are included under Protective Measures Assessment Protocol categories from the Phase II AFTT EIS/OEIS. These Protective Measures Assessment Protocol categories indicate the amount of mapped substrate that may be protected by Navy mitigation measures. However, the Protective Measures Assessment Protocol areas were not excluded from the quantitative impacts analysis due to how Protective Measures Assessment Protocol is implemented. For more information on the substrates protected under the Protective Measures Assessment Protocol see Chapter 5 (Mitigation).

The percentage of impacted substrate (Scenario 1) was calculated by totaling the impact footprint of individual activities divided by the total area of a given substrate in the training or testing area for which the impacts could occur. The results are provided in Table F-18 through Table F-26.

Assumptions used in the Scenario 1 analysis included:

- Areas of unknown substrate type were not included in the analysis.
- The analysis focused on substrates that are likely to have habitat for sedentary benthic organisms; therefore, areas that are not likely to have substrate inhabited by these organisms (i.e., the Atlantic Basin and Abyssal Zone open ocean areas) were excluded from the analysis.
- Artificial substrate was removed from the analysis because it was inconsistently mapped or mapped with a degree of uncertainty considered too high for quantitative analysis.

The above assumptions also applied to Scenario 2 (Proportional Impacts), which used the proportion of a substrate type in an analysis dimension (i.e., training or testing area) multiplied by the total military expended material or crater footprints. The resulting acres indicated the impact area expected if the military expended materials or bottom explosions were distributed uniformly across the training or testing area. In other words, a majority proportion of the military expended material footprint would impact soft substrate if the majority of the analysis dimension was soft substrate. The results are provided in Table F-27 through Table F-30. This scenario is considered more realistic than Scenario 1, yet still unlikely as it does not account for areas of concentrated training, nor does it account for the clumping of military expended materials and explosives in a particular area and over a particular substrate type where a training or testing activity occurs.

F.1.1 Military Expended and Recovered Material – Training Activities

Table F-2 through Table F-13 show military expended and recovered materials and impact footprints within the AFTT Study Area for both a Single Year and Five Year totals.

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Table F-2: Number and Impacts* of Military Expended Materials Proposed for Use During Training Activities in a Single Year Under Alternatives 1 and 2

			Range Complex															
			Northeast		VACAPES		Navy Cherry Point		JAX		Key West		GOMEX		Other AFTT Area		SINKEX Area	
Military Expended Materials	Size (ft.^{2})	Impact Footprint (ft.^{2})	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)
Bombs																		
Bombs (Explosive)	8.1203	112.9048	0	0.0000	88	0.2281	0	0.0000	56	0.1451	0	0.0000	4	0.0104	0	0.0000	12	0.0311
Bombs (Non-Explosive)	8.1203	112.9048	0	0.0000	2,188	5.6712	596	1.5448	1,360	3.5250	0	0.0000	270	0.6998	0	0.0000	0	0.0000
Projectiles																		
Small-Caliber (Non-Explosive)	0.0301	0.1216	27,000	0.0754	2,262,000	6.3145	393,000	1.0971	1,026,000	2.8641	0	0.0000	83,000	0.2317	100,000	0.2792	0	0.0000
Small-Caliber (Casing Only)	0.0151	0.0301	0	0.0000	5,000	0.0035	0	0.0000	5,000	0.0035	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Medium-Caliber (Explosive)	0.056	0.2239	0	0.0000	46,100	0.2370	20,000	0.1028	45,600	0.2344	0	0.0000	6,000	0.0308	0	0.0000	0	0.0000
Medium Caliber (Non-Explosive)	0.056	0.2239	1,000	0.0051	658,561	3.3850	328,149	1.6867	383,861	1.9731	28,000	0.1439	28,950	0.1488	21,150	0.1087	0	0.0000
Large-Caliber (Explosive)	1.0097	4.0386	0	0.0000	762	0.0706	210	0.0195	642	0.0595	0	0.0000	114	0.0106	114	0.0106	200	0.0185
Large-Caliber (Non-Explosive)	1.0097	4.0386	0	0.0000	4,930	0.4571	1,234	0.1144	2,534	0.2349	0	0.0000	498	0.0462	210	0.0195	0	0.0000
Large-Caliber (Casing only)	0.5048	1.0097	0	0.0000	0	0.0000	1,040	0.0241	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Missiles																		
Missiles (Explosive)	37.6691	74.7338	0	0.0000	32	0.0007	4	0.0001	4	0.0001	0	0.0000	4	0.0001	4	0.0001	0	0.0000
Rockets (Explosive)	0.7987	1.5974	2	0.0034	199	0.3414	187	0.3208	192	0.3294	8	0.0137	2	0.0034	0	0.0000	4	0.0069
Rockets (Non-Explosive)	0.7987	1.5974	0	0.0000	1,748	0.0641	76	0.0028	1,824	0.0669	0	0.0000	190	0.0070	0	0.0000	0	0.0000
Rockets (Non-Explosive): Flechette	0.7987	1.5974	1	0.0000	1,835	0.0673	304	0.0111	2,095	0.0768	0	0.0000	191	0.0070	0	0.0000	0	0.0000
Countermeasures																		
Chaff-Air Cartridges	0.0011	0.0022	0	0.0000	2,080	0.0001	25,760	0.0013	47,840	0.0024	48,000	0.0024	288	0.0000	0	0.0000	0	0.0000
Chaff - Ship Cartridges	2.0000	4.0000	0	0.0000	264	0.0242	480	0.0441	516	0.0474	0	0.0000	120	0.0110	0	0.0000	0	0.0000
Flares	1.2196	4.8782	0	0.0000	1,000	0.1120	22,300	2.4973	38,000	4.2555	31,000	3.4716	1,840	0.2061	0	0.0000	0	0.0000
Targets																		
Air Target (Decoy)	14.0216	28.0432	2	0.0013	81	0.0521	52	0.0335	61	0.0393	9	0.0058	2	0.0013	0	0.0000	0	0.0000
Air Target (Drone)	95.64	191.2	0	0.0000	18	0.0790	28	0.1229	7	0.0307	2	0.0088	0	0.0000	0	0.0000	0	0.0000
Surface Target (Mobile)	5.7522	11.5034	0	0.0000	70	0.0185	23	0.0061	78	0.0206	0	0.0000	3	0.0008	0	0.0000	0	0.0000
Surface Target (Stationary)	96.8752	193.7504	20	0.0890	4,512	20.0689	1,298	5.7734	3,013	13.4015	0	0.0000	334	1.4856	200	0.0000	0	0.0000
Mine Shapes (Non-Explosive)	25.7903	51.5807	0	0.0000	221	0.2617	78	0.0924	78	0.0924	2	0.0024	93	0.1101	0	0.0000	0	0.0000
Ship Hulk	316,136	632,272	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	1	14.5150
Other																		
Grenades (Explosive)	0.1044	0.2088	56	0.0003	4,070	0.0195	28	0.0001	28	0.0001	0	0.0000	28	0.0001	0	0.0000	0	0.0000
AMNS Neutralizer (Explosive)	1.6286	3.2572	0	0.0000	62	0.0046	1	0.0001	2	0.0001	0	0.0000	22	0.0016	0	0.0000	0	0.0000
Anchor - Other	3.1248	6.2495	0	0.0000	11	0.0016	10	0.0014	4	0.0006	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Compression Pad or Plastic Piston	0.0043	0.0086	0	0.0000	1,000	0.0002	22,300	0.0044	38,000	0.0075	31,000	0.0061	1,840	0.0004	0	0.0000	0	0.0000
Endcap – Chaff and Flare	0.0022	0.0043	0	0.0000	3,120	0.0003	48,108	0.0047	85,888	0.0085	79,008	0.0078	2,128	0.0002	0	0.0000	0	0.0000
Fiber Optic Can	0.0011	0.0022	0	0.0000	62	0.0000	1	0.0000	2	0.0000	0	0.0000	22	0.0000	0	0.0000	0	0.0000
Flare O-Ring	0.0043	0.0086	0	0.0000	1,040	0.0002	22,348	0.0044	38,048	0.0075	31,008	0.0061	1,840	0.0004	0	0.0000	0	0.0000
Illumination Flare	1.2196	4.8782	0	0.0000	40	0.0045	48	0.0054	48	0.0054	8	0.0009	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo (Explosive)	39.6155	79.2299	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	1	0.0018
Heavyweight Torpedo Accessories	0.1615	3.2367	24	0.0018	8	0.0006	0	0.0000	48	0.0036	0	0.0000	0	0.0000	0	0.0000	1	0.0001
Lightweight Torpedo Accessories	1.1011	2.0215	0	0.0000	13	0.0006	0	0.0000	44	0.0020	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Marine Marker	0.9752	3.8987	0	0.0000	1,022	0.0915	332	0.0297	1,060	0.0949	30	0.0027	53	0.0047	24	0.0021	0	0.0000
Decelerator/Parachute - Medium	254.5000	508.9000	0	0.0000	40	0.4673	48	0.5608	48	0.5608	8	0.0935	0	0.0000	0	0.0000	0	0.0000
Decelerator/Parachute- Large	1,963.5000	3,926.9000	1	0.0901	30	2.7045	0	0.0000	1	0.0901	0	0.0000	1	0.0901	0	0.0000	0	0.0000
Decelerator/Parachute – Extra-Large	5,026.5000	10,053.0900	0	0.0000	5	1.1539	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
JATO Bottles	3.6067	7.2134	1	0.0002	35	0.0058	0	0.0000	1	0.0002	0	0.0000	1	0.0002	0	0.0000	0	0.0000
Total			***28,107***	***0.27***	***3,002,374***	***41.92***	***888,047***	***14.11***	***1,722,097***	***28.19***	***248,083***	***3.77***	***127,842***	***3.11***	***121,706***	***0.42***	***219***	***14.57***

Notes: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.^{2}=square feet; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes

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Table F-3: Number and Impacts* of Military Expended Materials Proposed for Use During Training Activities in a Single Year Under Alternatives 1 and 2–Inshore Waters

Location	Military Expended Materials											
	Projectiles		Targets		Other						Countermeasure	
	Small Caliber (Non-explosive)		Mine Shapes		Marine Marker		Flare O-Ring		Compression Pad/Piston		Flare	
	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)
Narragansett Bay, RI	8,320	0.0232	0	0.0000	64	0.0058	0	0.0000	0	0.0000	0	0.0000
James River and Tributaries, VA	97,920	0.2733	0	0.0000	728	0.652	20,400	0.0040	20,400	0.0040	20,400	2.2846
York River, VA	0	0.0000	0	0.0000	20	0.0018	0	0.0000	0	0.0000	0	0.0000
Lower Chesapeake Bay, VA	78,000	0.2177	2	0.0024	230	0.0206	0	0.0000	0	0.0000	0	0.0000
Cooper River, SC	5,100	0.0142	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Port Canaveral, FL	12,800	0.0357	0	0.000	64	0.0057	0	0.0000	0	0.0000	0	0.0000

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acres

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Table F-4: Number and Impacts* of Military Expended Materials Proposed for Use During Training Activities in a Single Year with Differences between Alternatives 1 and 2

Military Expended Materials	Size (ft.^{2})	Impact Footprint (ft.^{2})	Range Complex: Northeast Number	Northeast Impact (Acre)	VACAPES Number	VACAPES Impact (Acre)	Navy Cherry Point Number	Navy Cherry Point Impact (Acre)	JAX Number	JAX Impact (Acre)	Key West Number	Key West Impact (Acre)	GOMEX Number	GOMEX Impact (Acre)	Other Training Locations: Other AFTT Area Number	Other AFTT Area Impact (Acre)
Alternative 1																
Countermeasures																
Acoustic Countermeasures	0.3311	1.2432	84	0.0024	51	0.0015	24	0.0007	184	0.0053	0	0.0000	0	0.0000	88	0.0025
Targets																
Subsurface Target (Mobile)	1.2206	2.4413	82	0.0046	304	0.0170	98	0.0045	1,057	0.0621	0	0.0000	3	0.0001	134	0.0075
Other																
Buoy (Non-Explosive)	0.9752	3.8987	0	0.0000	24	0.002148	17	0.0015	116	0.0104	0	0.0000	0	0.0000	0	0.0000
Sonobuoys (Non-Explosive)	1.2207	2.4413	2,882	0.1615	7,484	0.4194373	2,542	0.1425	27,237	1.5265	0	0.0000	0	0.0000	432	0.0242
Expended Bathythermograph	0.2771	0.5554	142	0.0018	414	0.0052786	108	0.0014	1,353	0.0173	0	0.0000	5	0.0000	154	0.0020
Decelerator/Parachute - Small	9.0417	18.0834	2,882	1.1964	7,497	3.1122876	2,542	1.0553	27,265	11.3187	0	0.0000	0	0.0000	432	0.1793
		Total	***6,072***	***1.3668***	***15,774***	***3.5576***	***5,331***	***1.2058***	***57,212***	***12.9402***	***0***	***0.0000***	***8***	***0.0001***	***1,240***	***0.2155***
Alternative 2																
Countermeasures																
Acoustic Countermeasures	0.3311	1.2432	84	0.0024	51	0.0015	24	0.0007	184	0.0053	0	0.0000	6	0.0002	88	0.0025
Targets																
Subsurface Target (Mobile) - Expended	1.2206	2.4413	84	0.0047	414	0.0225	125	0.0061	1,269	0.0744	0	0.0000	5	0.0003	134	0.0075
Other																
Buoy (Non-Explosive)	0.9752	3.8987	0	0.0000	34	0.0030	22	0.0020	186	0.0166	0	0.0000	16	0.0014	0	0.0000
Sonobuoys (Non-Explosive)	1.2207	2.4413	2,882	0.1615	7,484	0.4194	2,542	0.1425	27,237	1.5265	0	0.0000	702	0.0393	432	0.0242
Bathythermograph - Expended	0.2771	0.5554	142	0.0018	439	0.0056	113	0.0014	1,391	0.0177	0	0.0000	128	0.0016	154	0.0020
Small Decelerator/Parachute	2.8438	5.6876	2,882	1.1964	7,492	3.1102	2,542	1.0553	27,265	11.3187	0	0.0000	702	0.2914	432	0.1793
		Total	***6,074***	***1.3669***	***15,914***	***3.5622***	***5,368***	***1.2079***	***57,532***	***12.9592***	***0***	***0.0000***	***1,559***	***0.3343***	***1,240***	***0.2155***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.^{2}=square feet; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2.

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Table F-3: Number and Impacts* of Military Expended Materials Proposed for Use During Training Activities in Five Years Under Alternatives 1 and 2

			Range Complex															
			Northeast		*VACAPES*		*Navy Cherry Point*		*JAX*		*Key West*		*GOMEX*		*Other AFTT Area*		*SINKEX Area*	
Military Expended Materials	*Size (ft²)*	*Impact Footprint (ft²)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Bombs																		
Bombs (Explosive)	8.1203	112.9048	0	0.0000	500	1.2960	0	0.0000	250	0.6480	0	0.0000	20	0.0518	0	0.0000	60	0.1555
Bombs (Non-Explosive)	8.1203	112.9048	0	0.0000	10,940	28.3558	2,980	7.7240	6,800	17.6252	0	0.0000	1,350	3.4991	0	0.0000	0	0.0000
Projectiles																		
Small-Caliber (Non-Explosive)	0.0301	0.1216	135,000	0.3769	11,310,000	31.5725	1,965,000	5.4854	5,130,000	14.3207	0	0.0000	415,000	1.1585	500,000	1.3958	0	0.0000
Small-Caliber (Casing Only)	0.0151	0.0301	0	0.0000	25,000	0.0173	0	0.0000	25,000	0.0173	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Medium-Caliber (Explosive)	0.056	0.2239	0	0.0000	230,500	1.1848	100,000	0.5140	228,000	1.1719	0	0.0000	30,000	0.1542	0	0.0000	0	0.0000
Medium Caliber (Non-Explosive)	0.056	0.2239	5,000	0.0257	3,292,805	16.9251	1,640,745	8.4335	1,919,305	9.8653	140,000	0.7196	144,750	0.7440	100,750	0.5179	0	0.0000
Large-Caliber (Explosive)	1.0097	4.0386	0	0.0000	3,810	0.3532	1,050	0.0973	3,210	0.2976	0	0.0000	570	0.0528	570	0.0528	1,000	0.0927
Large-Caliber (Non-Explosive)	1.0097	4.0386	0	0.0000	24,650	2.2854	6,170	0.5720	12,670	1.1747	0	0.0000	2,490	0.2309	1,050	0.0973	0	0.0000
Large-Caliber (Casing only)	0.5048	1.0097	0	0.0000	0	0.0000	5,200	0.1205	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Kinetic Energy Round	0.5048	1.0100	0	0.0000	160	0.0037	20	0.0005	20	0.0005	0	0.0000	20	0.0005	20	0.0005	0	0.0000
Missiles																		
Missiles (Explosive)	37.6691	74.7338	10	0.0172	995	1.7071	935	1.6041	960	1.6470	40	0.0686	10	0.0172	0	0.0000	20	0.0343
Rockets (Explosive)	0.7987	1.5974	0	0.0000	8,740	0.3205	380	0.0139	9,120	0.3344	0	0.0000	950	0.0348	0	0.0000	0	0.0000
Rockets (Non-Explosive)	0.7987	1.5974	5	0.0002	9,175	0.3365	1,520	0.0557	10,474	0.3841	0	0.0000	955	0.0350	0	0.0000	0	0.0000
Rockets (Non-Explosive): Flechette	0.7987	1.5974	0	0.0000	475	0.0174	0	0.0000	551	0.0202	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Countermeasures																		
Chaff-Air Cartridges	0.0011	0.0022	0	0.0000	10,400	0.0005	128,800	0.0065	239,200	0.0121	240,000	0.0121	1,440	0.0001	0	0.0000	0	0.0000
Chaff - Ship Cartridges	2.0000	4.0000	0	0.0000	1,320	0.1212	2,400	0.2204	2,580	0.2369	0	0.0000	600	0.0551	0	0.0000	0	0.0000
Flares	1.2196	4.8782	0	0.0000	5,000	0.5599	111,500	12.4867	190,000	21.2777	155,000	17.3581	9,200	1.0303	0	0.0000	0	0.0000
Targets																		
Air Target - Decoy	14.0216	28.0432	10	0.0064	405	0.2607	460	0.2961	305	0.1964	47	0.0303	10	0.0064	0	0.0000	0	0.0000
Air Target - Drone	95.64	191.2	2	0.0088	92	0.4038	138	0.6057	34	0.1492	8	0.0351	2	0.0088	0	0.0000	0	0.0000
Surface Targets (Mobile)	5.7522	11.5034	0	0.0000	348	0.0919	114	0.0301	388	0.1025	0	0.0000	12	0.0032	0	0.0000	0	0.0000
Surface Targets (Stationary)	96.8752	193.7504	100	0.4448	22,560	100.3445	6,490	28.8668	15,065	67.0076	0	0.0000	1,670	7.4280	980	4.3589	0	0.0000
Mine Shapes (Non-Explosive)	25.7903	51.5807	0	0.0000	1,105	1.3085	390	0.4618	390	0.4618	8	0.0095	466	0.5518	0	0.0000	0	0.0000
Ship Hulk	316,136	632,272	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	5	72.5748
Other																		
Grenades (Explosive)	0.1044	0.2088	280	0.0013	20,350	0.0975	140	0.0007	140	0.0007	0	0.0000	140	0.0007	0	0.0000	0	0.0000
ANMS Neutralizer (Explosive)	1.6286	3.2572	0	0.0000	306	0.0229	5	0.0004	6	0.0004	0	0.0000	106	0.0079	0	0.0000	0	0.0000
Anchor - Other	3.1248	6.2495	0	0.0000	55	0.0079	50	0.0072	20	0.0029	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Compression Pad or Plastic Piston	0.0043	0.0086	0	0.0000	5,000	0.0010	111,500	0.0220	190,000	0.0375	155,000	0.0306	9,200	0.0018	0	0.0000		0.0000
Endcap - Chaff and Flare	0.0022	0.0043	0	0.0000	15,600	0.0015	240,540	0.0237	429,440	0.0424	395,040	0.0390	10,640	0.0011	0	0.0000	0	0.0000
Fiber Optic Can	0.0011	0.0022	0	0.0000	306	0.0000	5	0.0000	6	0.0000	0	0.0000	106	0.0000	0	0.0000	0	0.0000
Flare O-Ring	0.0043	0.0086	0	0.0000	5,200	0.0010	111,740	0.0221	190,240	0.0376	155,040	0.0306	9,200	0.0018	0	0.0000	0	0.0000
Illumination Flare	1.2196	4.8782	0	0.0000	200	0.0224	240	0.0269	240	0.0269	40	0.0045	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo (Explosive)	39.6155	79.2299	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	5	0.0091
Heavyweight Torpedo Accessories	0.1615	3.2367	120	0.0089	40	0.0030	0	0.0000	240	0.0178	0	0.0000	0	0.0000	0	0.0000	5	0.0004
Lightweight Torpedo Accessories	1.1011	2.0215	0	0.0000	65	0.0030	0	0.0000	220	0.0102	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Marine Marker	0.9752	3.8987	0	0.0000	5,110	0.4574	1,660	0.1486	5,300	0.4744	150	0.0134	265	0.0237	120	0.0107	0	0.0000
Decelerator/Parachute - Medium	254.5000	508.9000	0	0.0000	200	2.3365	240	2.8039	240	2.8039	40	0.4673	0	0.0000	0	0.0000	0	0.0000
Decelerator/Parachute - Large	1,963.5000	3,926.9000	5	0.4507	150	13.5224	0	0.0000	5	0.4507	0	0.0000	5	0.4507	0	0.0000	0	0.0000
Decelerator/Parachute - Extra-Large	5,026.5000	10,053.0900	0	0.0000	25	5.7697	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Sabot - Kinetic Energy Round	1.2196	4.8782	0	0.0000	160	0.0179	20	0.0022	20	0.0022	0	0.0000	20	0.0022	20	0.0022	0	0.0000
JATO bottles	3.6067	7.2134	5	0.0008	175	0.0290	0	0.0000	5	0.0008	0	0.0000	5	0.0008	0	0.0000	0	0.0000
Total			***140,537***	***1.3417***	***15,011,922***	***209.7595***	***4,440,432***	***70.6528***	***8,610,444***	***140.8594***	***1,240,413***	***18.8188***	***639,202***	***15.5533***	***603,510***	***6.4362***	***1,095***	***72.8669***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.^{2}=square feet; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes

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Table F-6: Number and Impacts* of Military Expended Materials Proposed for Use During Training Activities in Five Years Under Alternatives 1 and 2 – Inshore Waters

	Military Expended Materials													
	Projectiles		*Targets*		*Other*								*Countermeasure*	
	Small Caliber (non-explosive)		*Mine Shape (non-explosive)*		*Marine Marker*		*Endcap – Chaff & Flare*		*Flare O-Ring*		*Compression Pad or Plastic Piston*		*Flare*	
Location	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Narragansett Bay, RI	41,600	0.1161	0	0.0000	320	0.0286	0	0.0000	0	0.0000	0	0.0000	0	0.0000
James River and Tributaries, VA	489,600	1.3667	0	0.0000	3,640	0.3258	102.000	0.0101	102,000	0.0201	102,000	0.0201	102,000	11.4228
York River, VA	0	0.0000	8	0.0095	100	0.0090	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Lower Chesapeake Bay, VA	390,000	1.0887	0	0.0000	1,150	0.1029	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Cooper River, SC	25,500	0.0712	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Port Canaveral, FL	64,000	0.1787	0	0.0000	320	0.0286	0	0.0000	0	0.0000	0	0.0000	0	0.0000

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre

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Table F-7: Number and Impacts* of Military Expended Materials Proposed for Use During Training Activities in Five Years with Differences between Alternatives 1 and 2

			Range Complex														
		Impact	Northeast		VACAPES		Navy Cherry Point		JAX		Key West		GOMEX		Other AFTT Area	
Military Expended Materials	*Size (ft.²)*	*Footprint (ft.²)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Alternative 1																
Countermeasures																
Acoustic Countermeasures	0.3311	1.2432	420	0.0120	255	0.0073	120	0.0034	920	0.0263	0	0.0000	0	0.0000	441	0.0126
Targets																
Subsurface Target (Mobile)	1.2206	2.4413	408	0.0229	1,520	0.0852	488	0.0226	5,303	0.2972	0	0.0000	13	0.0007	670	0.0375
Other																
Buoy (Non-Explosive)	0.9752	3.8987	0	0.0000	114	0.0102	73	0.0065	550	0.0492	0	0.0000	0	0.0000	0	0.0000
Sonobuoys (Non-Explosive)	1.2207	2.4413	14,410	0.8076	37,204	2.0851	12,332	0.6911	134,673	7.5477	0	0.0000	0	0.0000	2,160	0.1211
Expended Bathythermograph	0.2771	0.5554	708	0.0090	2,065	0.0263	535	0.0068	6,402	0.0816	0	0.0000	25	0.0003	771	0.0098
Decelerator/Parachute - Small	9.0417	18.0834	14,410	5.9821	37,244	15.4614	12,332	5.1195	134,813	55.9660	0	0.0000	0	0.0000	2,160	0.8967
Total			***30,356***	***6.8336***	***78,402***	***17.6755***	***25,880***	***5.8500***	***282,661***	***63.9680***	***0***	***0.0000***	***38***	***0.0010***	***6,202***	***1.0777***
Alternative 2																
Countermeasures																
Acoustic Countermeasures	0.3311	1.2432	420	0.0120	255	0.0073	120	0.0034	920	0.0263	0	0.0000	30	0.0009	441	0.0126
Targets																
Subsurface Target (Mobile)	1.2206	2.4413	420	0.0286	2,070	0.1124	625	0.0303	6,362	0.3566	0	0.0000	25	0.0014	670	0.0375
Other																
Buoy (Non-Explosive)	0.9752	3.8987	0	0.0000	170	0.0152	110	0.0098	930	0.0832	0	0.0000	80	0.0072	0	0.0000
Sonobuoys (Non-Explosive)	1.2207	2.4413	14,410	0.8076	37,420	2.0972	12,710	0.7123	136,185	7.6324	0	0.0000	3,510	0.1967	2,160	0.1211
Expended Bathythermograph	0.2771	0.5554	708	0.0090	2,193	0.0280	563	0.0072	6,953	0.0887	0	0.0000	640	0.0082	771	0.0098
Decelerator/Parachute - Small	9.0417	18.0834	14,410	5.9821	37,460	15.5511	12,710	5.2764	136,325	56.5937	0	0.0000	3,510	1.4571	2,160	0.8967
Total			***30,368***	***6.8393***	***79,568***	***17.8111***	***26,838***	***6.0394***	***287,675***	***64.7808***	***0***	***0.0000***	***7,795***	***1.6714***	***6,202***	***1.0777***

Note: * Calculation for “Impact (Acre)” Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; AMNS = Airborne Mine Neutralization System; ft.²=square feet; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2.

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Table F-8: Number of Recovered Materials Proposed for Use During Training Activities In a Single Year Under Alternatives 1 and 2

	Range Complex						Other Training Locations
	Northeast	VACAPES	Navy Cherry Point	JAX	Key West	GOMEX	Other AFTT Area
Recovered Materials	**Number**	**Number**	**Number**	**Number**	**Number**	**Number**	**Number**
Other							
Air-Launched Lightweight Torpedo (Non-Explosive)	0	8	0	28	0	0	0
Heavyweight Torpedo (Non-explosive)	24	8	0	48	0	0	0
Surface-Launched Lightweight Torpedo (Non-Explosive)	0	5	0	16	0	0	0
Targets							
Air Target (Decoy)	0	570	61	211	69	0	10
Air Target (Drones)	2	58	48	51	6	2	0
Surface Targets (Mobile)	40	6,547	2,047	4,206	0	400	150
Surface Targets (Stationary)	0	38	4	12	0	4	0
Subsurface Targets (Mobile)	0	0	0	46	0	0	0
Total	***66***	***7,234***	***2,160***	***4,618***	***75***	***406***	***160***

Note: ac=acre; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes

Table F-9: Number and Impacts* of Recovered Bottom Placed Materials Proposed for Use During Training Activities In a Single Year Under Alternatives 1 and 2

			Range Complex												Other Training Locations	
			Northeast		VACAPES		Navy Cherry Point		JAX		Key West		GOMEX		NSWC Panama City	
Recovered Materials	**Size (ft.^{2})**	**Impact Footprint (ft.^{2})**	**Number**	**Impact** (Acre)	**Number**	**Impact** (Acre)	**Number**	**Impact** (Acre)	**Number**	**Impact** (Acre)	**Number**	**Impact** (Acre)	**Number**	**Impact** (Acre)	**Number**	**Impact** (Acre)
Mine Shape (Non-explosive)	25.7903	51.5807	0	0.0000	3,777	4.4725	812	0.9615	1,402	1.6602	13	0.0154	764	0.9047	244	0.2889
Metal Plates	2.7782	5.5563	0	0.0000	0	0.0000	0	0.0000	0	0.0000	5	0.0006	0	0.0000	0	0.0000
Bottom Placed Instruments	2.0000	4.0000	0	0.0000	96	0.0088	0	0.0000	48	0.0044	48	0.0044	96	0.0088	0	0.0000
Total					***0***	***0.0000***	***3,873***	***4.4813***	***812***	***0.9615***	***1,450***	***1.6646***	***66***	***0.0204***	***860***	***0.9135***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.^{2}=square feet; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes

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Table F-10: Number and Impacts* of Recovered Bottom Placed Materials Proposed for Use During Training Activities in a Single Year Under Alternatives 1 and 2 - Inshore Waters

	Military Recovered Materials					
	Projectiles		Targets		Other	
	Metal Plates		Mine Shapes (Non-Explosive)		I-Beam Demolition Structure	
Location	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)
Beaumont, TX	0	0.0000	8	0.0095	0	0
Boston, MA	0	0.0000	4	0.0047	0	0
Corpus Christi, TX	0	0.0000	4	0.0047	0	0
Delaware Bay, DE	0	0.0000	4	0.0047	0	0
Earle, NJ	0	0.0000	4	0.0047	0	0
Hampton Roads, VA	0	0.0000	8	0.0095	0	0
James River, VA	0	0.0000	75	0.0888	0	0
Kings Bay, GA	0	0.0000	26	0.0308	0	0
Lower Chesapeake Bay, VA	6	0.0008	6	0.0071	0	0
Mayport, FL	0	0.0000	4	0.0047	0	0
Morehead City, NC	0	0.0000	4	0.0047	0	0
Port Canaveral, FL	0	0.0000	4	0.0047	0	0
Savannah, GA	0	0.0000	4	0.0047	0	0
Truman Harbor	0	0.0000	0	0.0000	42	0.0056
Demolition Key	0	0.0000	0	0.0000	42	0.0056
Tampa, FL	0	0.0000	4	0.0047	0	0
Wilmington,, DE	0	0.0000	4	0.0047	0	0
York River, VA	0	0.0000	19	0.0225	0	0

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560; ac=acre

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Table F-11: Number of Recovered Materials Proposed for Use During Training Activities In Five Years Under Alternatives 1 and 2

Recovered Materials		*Range Complex*						*Other Training Locations*
		Northeast	*VACAPES*	*Navy Cherry Point*	*JAX*	*Key West*	*GOMEX*	*Other AFTT Area*
		Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Other								
Air-Launched Lightweight Torpedo (Non-Explosive)		0	40	0	140	0	0	0
Surface-Launched Lightweight Torpedo (Non-Explosive)		0	25	0	80	0	0	0
Heavyweight Torpedo (Non-explosive)		120	40	0	240	0	0	0
Targets								
Air Target - Decoy		0	2,850	305	1,055	343	0	50
Air Target - Drone		8	288	238	257	32	8	0
Surface Target (Mobile)		200	32,732	10,236	21,032	0	1,998	730
Surface Target (Stationary)		0	190	20	60	0	20	0
Subsurface Targets (Mobile)	Alternative 1	0	0	0	232	0	0	0
	Alternative 2				272			
Total	**Alternative 1**	***328***	***36,165***	***10,799***	***23,096***	***375***	***2,026***	***780***
	Alternative 2				***23,136***			

Note: ac=acre; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes
Blue shading indicates numbers of recovered materials that differ between Alternatives 1 and 2.

Table F-12: Number and Impacts* of Recovered Bottom Placed Materials Proposed for Use During Training Activities In Five Years Under Alternatives 1 and 2

Recovered Materials	*Size (ft.²)*	*Impact Footprint (ft.²)*	*Range Complex*												*Other Training Locations*	
			Northeast		*VACAPES*		*Navy Cherry Point*		*JAX*		*Key West*		*GOMEX*		*NSWC Panama City*	
			Number	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Mine Shape (Non-explosive)	25.7903	51.5807	0	0.0000	18,881	22.3576	4,060	4.8076	7,002	8.2913	63	0.0746	3,811	4.5127	1,220	1.4446
Metal Plates	2.7782	5.5563	0	0.0000	0	0.0000	0	0.0000	0	0.0000	25	0.0032	0	0.0000	0	0.0000
Bottom Placed Instruments	2.0000	4.0000	0	0.0000	480	0.0441	0	0.0000	240	0.0220	240	0.0220	480	0.0441	0	0.0000
		Total	***0***	***0.0000***	***105,670***	***124.6027***	***24,990***	***29.5914***	***24,970***	***29.3055***	***295***	***0.0607***	***8,095***	***9.0612***	***14,640***	***17.3357***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.²=square feet; GOMEX= Gulf of Mexico; JAX=Jacksonville; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; VACAPES=Virginia Capes

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Table F-13: Number and Impacts* of Recovered Bottom Placed Materials Proposed for Use During Training Activities in Five Years Under Alternatives 1 and 2 – Inshore Waters

Location	Recovered Materials					
	Projectiles		Targets		Other	
	Metal Plates		Mine Shapes (Non-Explosive)		I-Beam Demolition Structure	
	Number	Impact (Acre)	Number	Impact (Acre)	Number	Impact (Acre)
Beaumont, TX	0	0.0000	24	0.0284	0	0.0000
Boston, MA	0	0.0000	12	0.0142	0	0.0000
Corpus Christi, TX	0	0.0000	12	0.0142	0	0.0000
Delaware Bay, DE	0	0.0000	12	0.0142	0	0.0000
Earle, NJ	0	0.0000	12	0.0142	0	0.0000
Hampton Roads, VA	0	0.0000	24	0.0284	0	0.0000
James River, VA	0	0.0000	425	0.5033	0	0.0000
Kings Bay, GA	0	0.0000	122	0.1445	0	0.0000
Lower Chesapeake Bay, VA	30	0.0038	1,503	1.7797	0	0.0000
Mayport, FL	0	0.0000	12	0.0142	0	0.0000
Morehead City, NC	0	0.0000	12	0.0142	0	0.0000
Port Canaveral, FL	0	0.0000	12	0.0142	0	0.0000
Savannah, GA	0	0.0000	12	0.0142	0	0.0000
Truman Harbor	0	0.0000	0	0.0000	210	0.0281
Demolition Key	0	0.0000	0	0.0000	210	0.0281
Tampa, FL	0	0.0000	12	0.0142	0	0.0000
Wilmington, DE	0	0.0000	12	0.0142	0	0.0000
York River, VA	0	0.0000	95	0.1125	0	0.0000

Note: * Calculation for "Impact (ac)" Column = ([Impact Footprint] x [Number]) / 43560; ac=acre

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F.1.2 MILITARY EXPENDED AND RECOVERED MATERIALS – TESTING ACTIVITIES

Table F-14 through Table F-21 show military expended and recovered materials and impact footprints within the AFTT Study Area for both Single Year and Five Year totals.

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Table F-14: Number and Impacts* of Military Expended Materials Proposed for Use During Testing Activities in a Single Year Under Alternatives 1 and 2

			Range Complex												Testing Ranges					
			Northeast		VACAPES		Navy Cherry Point		JAX		Key West		GOMEX		NUWC Newport		SFOMF		NSWC Panama City	
Military Expended Materials	***Size (ft.^{2})***	***Impact Footprint (ft.^{2})***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***
Bombs																				
Bombs (Explosive)	8.1203	112.9048	0	0.0000	4	0.0104	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Bombs (Non-Explosive)	8.1203	112.9048	0	0.0000	916	2.3742	0	0.0000	12	0.0311	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Projectiles																				
Small-Caliber (Non-Explosive)	0.0301	0.1216	4,800	0.0134	77,800	0.2172	4,800	0.0134	4,800	0.0134	4,800	0.0134	17,800	0.0497	0	0.0000	0	0.0000	7,000	0.0195
Medium-Caliber (Explosive)	0.056	0.2239	3,860	0.0198	17,270	0.0888	3,360	0.0173	14,860	0.0764	3,360	0.0173	3,360	0.0173	0	0.0000	0	0.0000	0	0.0000
Medium Caliber (Non-Explosive)	0.056	0.2239	9,060	0.0466	234,665	1.2062	8,160	0.0419	237,360	1.2200	32,660	0.1679	22,860	0.1175	0	0.0000	0	0.0000	5,100	0.0262
Large-Caliber (Explosive)	1.0097	4.0386	1,632	0.1513	4,763	0.4416	1,632	0.1513	7,876	0.7302	2,332	0.2162	2,423	0.2246	0	0.0000	0	0.0000	100	0.0093
Large-Caliber (Non-Explosive)	1.0097	4.0386	1,761	0.1633	8,147	0.7553	1,440	0.1335	14,524	1.3466	3,190	0.2958	2,774	0.2572	0	0.0000	0	0.0000	280	0.0260
Kinetic Energy Round	0.5048	1.0100	33,503	0.7768	33,503	0.7768	33,503	0.7768	33,503	0.7768	33,503	0.7768	33,503	0.7768	4	0.0001	4	0.0001	4	0.0001
Missiles																				
Missiles (Explosive)	37.6691	74.7228	10	0.0172	222	0.3808	0	0.0000	70	0.1201	0	0.0000	12	0.0206	0	0.0000	0	0.0000	0	0.0000
Missiles (Non-Explosive)	14.1771464	28.3543	25	0.0163	1,663	1.0825	25	0.0163	594	0.3866	32	0.0208	42	0.0273	0	0.0000	0	0.0000	0	0.0000
Rockets (Explosive)	0.7987	1.5974	0	0.0000	206	0.0076	0	0.0000	200	0.0073	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Rockets (Non-Explosive)	0.7987	1.5974	1	0.0000	759	0.0278	0	0.0000	407	0.0149	0	0.0000	1	0.0000	0	0.0000	0	0.0000	0	0.0000
Rockets (Non-Explosive): Flechette	0.7987	1.5974	0	0.0000	249	0.0091	0	0.0000	136	0.0050	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Countermeasures																				
Acoustic Countermeasures	0.3311	1.2432	843	0.0241	1,163	0.0332	708	0.0202	1,508	0.0430	0	0.0000	697	0.0199	64	0.0018	17	0.0005	0	0.0000
Chaff - Air Cartridge	0.0011	0.0022	0	0.0000	20,595	0.0010	0	0.0000	400	0.0000	0	0.0000	1,200	0.0001	0	0.0000	0	0.0000	0	0.0000
Chaff - Ship Cartridge	2.0000	4.0000	144	0.0132	1,019	0.0936	144	0.0132	480	0.0441	144	0.0132	144	0.0132	0	0.0000	0	0.0000	0	0.0000
Anti-Torpedo Torpedo	4.524	9.0847	78	0.0163	96	0.0200	36	0.0075	104	0.0217	0	0.0000	72	0.0150	0	0.0000	0	0.0000	0	0.0000
Flares	1.2196	4.8782	0	0.0000	20,195	2.2616	0	0.0000	0	0.0000	0	0.0000	600	0.0672	0	0.0000	0	0.0000	0	0.0000
Targets																				
Air Targets (Decoy)	14.0216	28.0432	0	0.0000	5	0.0032	0	0.0000	2	0.0013	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Air Targets (Drone)	95.64	191.2	6	0.0263	200	0.8779	8	0.0351	62	0.2721	6	0.0263	16	0.0702	6	0.0263	6	0.0263	6	0.0263
Surface Target (Mobile)	5.7522	11.5034	1	0.0003	153	0.0404	0	0.0000	19	0.0050	2	0.0005	2	0.0005	450	0.1188	0	0.0000	0	0.0000
Surface Target (Stationary)	96.8752	193.7504	172	0.7650	832	3.7007	172	0.7650	545	2.4241	178	0.7917	248	1.1031	484	2.1528	56	0.2491	0	0.0000
Subsurface Target (Stationary)	5.7522	11.5034	2,228	0.5884	1,142	0.3016	81	0.0214	320	0.0845	32	0.0085	960	0.2535	374	0.0988	84	0.0222	0	0.0000
Mine Shape (Non-explosive)	25.7903	51.5807	0	0.0000	127	0.1504	0	0.0000	122	0.1445	0	0.0000	232	0.2747	0	0.0000	40	0.0474	370	0.4381
Other																				
Air-Launched Lightweight Torpedo (Explosive)	19.1199	38.2399	1	0.0009	1	0.0009	1	0.0009	1	0.0009	1	0.0009	1	0.0009	0	0.0000	0	0.0000	0	0.0000
Anchor - Other	3.1248	6.2495	685	0.0983	343	0.0492	0	0.0000	20	0.0029	0	0.0000	338	0.0485	70	0.0100	654	0.0938	0	0.0000
Expended Bathythermograph	0.2771	0.5554	21,104	0.2691	9,740	0.1242	277	0.0035	561	0.0072	10	0.0001	9,813	0.1251	0	0.0000	4	0.0001	0	0.0000
Buoy (Explosive)	0.97521	3.8987	736	0.0659	368	0.0329	152	0.0136	152	0.0136	202	0.0181	368	0.0329	0	0.0000	0	0.0000	0	0.0000
Canister-Miscellaneous	2.0000	4.0000	240	0.0220	240	0.0220	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Compression Pad or Plastic Piston	0.0043	0.0086	0	0.0000	20,195	0.0040	0	0.0000	0	0.0000	0	0.0000	600	0.0001	0	0.0000	0	0.0000	0	0.0000
Concrete Slugs	0.0011	0.0022	38	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	38	0.0000	0	0.0000	0	0.0000	0	0.0000
Endcaps and Pistons - Non Chaff and Flare	0.0043	0.0860	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	379	0.0007	0	0.0000	0	0.0000
Endcap - Chaff and Flare	0.0022	0.0043	0	0.0000	40,790	0.0040	0	0.0000	400	0.0000	0	0.0000	1,800	0.0002	0	0.0000	0	0.0000	0	0.0000
Flare O-Ring	0.0043	0.0086	0	0.0000	20,195	0.0040	0	0.0000	0	0.0000	0	0.0000	600	0.0001	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo (Explosive)	39.6155	79.2299	1	0.0018	1	0.0018	1	0.0018	1	0.0018	1	0.0018	1	0.0018	0	0.0000	0	0.0000	0	0.0000
Anti-torpedo torpedo Accessories	1.1011	2.0215	78	0.0036	96	0.0045	36	0.0017	104	0.0048	0	0.0000	72	0.0033	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo Accessories	1.1615	3.2367	98	0.0073	128	0.0095	42	0.0031	134	0.0100	2	0.0001	84	0.0062	20	0.0015	6	0.0004	0	0.0000
Lightweight Torpedo Accessories	1.1011	2.0215	54	0.0025	225	0.0104	50	0.0023	213	0.0099	2	0.0001	54	0.0025	20	0.0009	0	0.0000	192	0.0089
Sabot - Kinetic Energy Round	1.2196	4.8782	33,503	3.7519	33,503	3.7519	33,503	3.7519	33,503	3.7519	33,503	3.7519	33,503	3.7519	4	0.0004	4	0.0004	4	0.0004
Sonobuoy (Explosive)	1.2207	2.4413	0	0.0000	0	0.0000	0	0.0000	0	0.0000	36	0.0020	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Surface-Launched Lightweight Torpedo (Explosive)	10.0782	20.1576	5	0.0023	5	0.0023	1	0.0005	5	0.0023	1	0.0005	5	0.0023	0	0.0000	0	0.0000	12	0.0056
Decelerator/Parachute- Large	1,963.5000	3,926.9000	1	0.0901	14	1.2621	0	0.0000	1	0.0901	0	0.0000	1	0.0901	0	0.0000	0	0.0000	0	0.0000
JATO Bottles	3.6067	7.2134	1	0.0002	14	0.0023	0	0.0000	1	0.0002	0	0.0000	1	0.0002	0	0.0000	0	0.0000	0	0.0000
Total			***114,669***	***6.95***	***551,552***	***20.15***	***88,132***	***5.79***	***353,000***	***11.66***	***113,997***	***6.12***	***134,225***	***7.37***	***1,875***	***2.41***	***875***	***0.44***	***13,068***	***0.6***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.^{2}=square feet; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes

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Table F-15: Number and Impacts* of Military Expended Materials Proposed for Use During Testing Activities in a Single Year with Differences between Alternatives 1 and 2

Military Expended Materials	*Size (ft.²)*	*Impact Footprint (ft.²)*	*Range Complex*												*Testing Ranges*					
			Northeast		*VACAPES*		*Navy Cherry Point*		*JAX*		*Key West*		*GOMEX*		*NUWC Newport*		*SFOMF*		*NSWC Panama City*	
			Number	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Alternative 1																				
Targets																				
Subsurface Target (Mobile)	1.2206	2.4415	54	0.0030	57	0.0032	7	0.0004	184	0.0103	3	0.0002	208	0.0117	516	0.0289	95	0.0053	0	0.0000
Other																				
Anchor - Mine	6.2495	12.5001	0	0.0000	2	0.0006	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	4	0.0011
Fiber Optic Can	0.0011	0.0022	0	0.0000	250	0.0000	0	0.0000	50	0.0000	0	0.0000	100	0.0000	0	0.0000	0	0.0000	328	0.0000
Buoy (Non-Explosive)	0.97521	3.8987	247	0.0221	217	0.0194	127	0.0114	218	0.0195	408	0.0365	127	0.0114	0	0.0000	0	0.0000	0	0.0000
Sonobuoys (Non-Explosive)	1.2207	2.4413	3,596	0.2015	5,505	0.3085	2,144	0.1202	5,847	0.3277	3,007	0.1685	2,027	0.1136	1,200	0.0673	32	0.0018	192	0.0108
ANMS Neutralizer (Explosive)	1.6286	3.2572	0	0.0000	250	0.0187	0	0.0000	50	0.0037	0	0.0000	100	0.0075	0	0.0000	0	0.0000	328	0.0245
Mines (Explosive)	25.7903	51.5807	0	0.0000	2	0.0024	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	4	0.0047
Decelerator/Parachute - Small	9.0417	18.0834	3,637	1.0040	5,711	2.3709	2,185	0.9071	6,037	2.5062	3,008	1.2487	2,068	0.8585	1,200	0.4982	32	0.0133	192	0.0797
		Total	***7,534***	***1.2307***	***11,994***	***2.7236***	***4,463***	***1.0390***	***12,386***	***2.8674***	***6,426***	***1.4539***	***4,630***	***1.0026***	***2,916***	***0.5943***	***159***	***0.0204***	***1,048***	***0.1209***
Alternative 2																				
Targets																				
Subsurface Target (Mobile)	1.2206	2.4412	55	0.0031	58	0.0033	8	0.0004	184	0.0103	3	0.0002	208	0.0117	516	0.0289	95	0.0053	0	0.0000
Other																				
Anchor - Mine	6.2495	12.5001	0	0.0000	7	0.0020	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	9	0.0026
Fiber Optic Can	0.0011	0.0022	0	0.0000	255	0.0000	0	0.0000	50	0.0000	0	0.0000	100	0.0000	0	0.0000	0	0.0000	333	0.0000
Buoy (Non-Explosive)	0.97521	3.8987	262	0.0234	222	0.0199	132	0.0118	244	0.0218	408	0.0365	127	0.0114	0	0.0000	0	0.0000	0	0.0000
Sonobuoys (Non-Explosive)	1.2207	2.4413	3,715	0.2082	5,548	0.3109	2,187	0.1226	6,062	0.3397	3,007	0.1685	2,027	0.1136	1,200	0.0673	32	0.0018	192	0.0108
ANMS Neutralizer (Explosive)	1.6286	3.2572	0	0.0000	255	0.0191	0	0.0000	50	0.0037	0	0.0000	100	0.0075	0	0.0000	0	0.0000	333	0.0249
Mines (Explosive)	25.7903	51.5807	0	0.0000	7	0.0083	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	9	0.0107
Decelerator/Parachute - Small	9.0417	18.0834	3,756	1.5593	5,754	2.3887	2,228	0.9249	6,252	2.5954	3,008	1.2487	2,068	0.8585	1,200	0.1567	32	0.0042	192	0.0797
		Total	***7,788***	***1.7940***	***12,106***	***2.7521***	***4,555***	***1.0598***	***12,842***	***2.9711***	***6,426***	***1.4539***	***4,630***	***1.0026***	***2,916***	***0.2529***	***159***	***0.0113***	***1,068***	***0.1286***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; AMNS = Airborne Mine Neutralization System; ft.²=square feet; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2.

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Table F-16: Number and Impacts* of Military Expended Materials Proposed for Use During Testing Activities in Five Years Under Alternatives 1 and 2

			Range Complex												*Testing Ranges*					
			Northeast		*VACAPES*		*Navy Cherry Point*		*JAX*		*Key West*		*GOMEX*		*NUWC Newport*		*SFOMF*		*NSWC Panama City*	
Military Expended Materials	*Size (ft.^{2})*	*Impact Footprint (ft.^{2})*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Bombs																				
Bombs (Explosive)	8.1203	112.9048	0	0.0000	20	0.0518	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Bombs (Non-Explosive)	8.1203	112.9048	0	0.0000	4,580	11.8711	0	0.0000	60	0.1555	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Projectiles																				
Small-Caliber (Non-Explosive)	0.0301	0.1216	24,000	0.0670	389,000	1.0859	24,000	0.0670	24,000	0.0670	24,000	0.0670	89,000	0.2484	0	0.0000	0	0.0000	35,000	0.0977
Large-Caliber (Explosive)	1.0097	4.0386	8,160	0.7565	23,815	2.2080	8,160	0.7565	39,380	3.6511	11,660	1.0810	12,115	1.1232	0	0.0000	0	0.0000	500	0.0464
Large-Caliber (Non-Explosive)	1.0097	4.0386	8,805	0.8163	40,735	3.7767	7,200	0.6675	72,620	6.7329	15,950	1.4788	13,870	1.2859	0	0.0000	0	0.0000	1,400	0.1298
Kinetic Energy Round	0.5048	1.0100	167,504	3.8838	167,504	3.8838	167,504	3.8838	167,504	3.8838	167,504	3.8838	167,504	3.8838	4	0.0001	4	0.0001	4	0.0001
Countermeasures																				
Acoustic Countermeasures	0.3311	1.2432	4,018	0.1147	5,814	0.1659	3,540	0.1010	7,145	0.2039	0	0.0000	3,484	0.0994	320	0.0091	84	0.0024	0	0.0000
Chaff-Air Cartridges	0.0011	0.0022	0	0.0000	102,975	0.0052	0	0.0000	2,000	0.0001	0	0.0000	6,000	0.0003	0	0.0000	0	0.0000	0	0.0000
Chaff - Ship Cartridges	2.0000	4.0000	720	0.0661	4,955	0.4550	720	0.0661	2,400	0.2204	720	0.0661	720	0.0661	0	0.0000	0	0.0000	0	0.0000
Flares	1.2196	4.8782	0	0.0000	100,975	11.3080	0	0.0000	0	0.0000	0	0.0000	3,000	0.3360	0	0.0000	0	0.0000	0	0.0000
Targets																				
Air Targets (Decoy)	14.0216	28.0432	0	0.0000	22	0.0142	0	0.0000	6	0.0039	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Air Target (Drone)	95.64	191.2	6	0.0263	976	4.2840	8	0.0351	286	1.2554	6	0.0263	56	0.2458	6	0.0263	6	0.0263	6	0.0263
Other																				
Air-Launched Lightweight Torpedo (Explosive)	19.1199	38.2399	3	0.0026	3	0.0026	3	0.0026	3	0.0026	3	0.0026	3	0.0026	0	0.0000	0	0.0000	0	0.0000
Anchor - Other	3.1248	6.2495	3,425	0.4914	1,713	0.2458	0	0.0000	100	0.0143	0	0.0000	1,688	0.2422	350	0.0502	3,270	0.4691	0	0.0000
Buoy (Explosive)	0.97521	3.8987	3,680	0.3294	1,840	0.1647	760	0.0680	760	0.0680	1,010	0.0904	1,840	0.1647	0	0.0000	0	0.0000	0	0.0000
Canister - Miscellaneous	2.0000	4.0000	1,200	0.1102	1,200	0.1102	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Compression Pad or Plastic Piston	0.0043	0.0086	0	0.0000	100,975	0.0199	0	0.0000	0	0.0000	0	0.0000	3,000	0.0006	0	0.0000	0	0.0000	0	0.0000
Concrete Slugs	0.0011	0.0022	190	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	190	0.0000	0	0.0000	0	0.0000	0	0.0000
Endcap - Chaff and Flare	0.0022	0.0043	0	0.0000	203,950	0.0201	0	0.0000	2,000	0.0002	0	0.0000	9,000	0.0009	0	0.0000	0	0.0000	0	0.0000
End Caps and Pistons - Non Chaff and Flare	0.0043	0.0860	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	1,895	0.0037	0	0.0000	0	0.0000
Flare O-Ring	0.0043	0.0086	0	0.0000	100,975	0.0199	0	0.0000	0	0.0000	0	0.0000	3,000	0.0006	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo (Explosive)	39.6155	79.2299	4	0.0073	4	0.0073	4	0.0073	4	0.0073	4	0.0073	4	0.0073	0	0.0000	0	0.0000	0	0.0000
Sabot - Kinetic Energy Round	1.2196	4.8782	167,054	18.7081	167,054	18.7081	167,054	18.7081	167,054	18.7081	167,054	18.7081	167,054	18.7081	4	0.0004	4	0.0004	4	0.0004
Sonobuoy (Explosive)	1.2207	2.4413	0	0.0000	0	0.0000	0	0.0000	0	0.0000	180	0.0101	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Surface-Launched Lightweight Torpedo (Explosive)	10.0782	20.1576	22	0.0102	22	0.0102	2	0.0009	22	0.0102	2	0.0009	22	0.0102	0	0.0000	0	0.0000	60	0.0278
Decelerator/Parachute - Large	1,963	3,926	5	0.4507	70	6.3104	0	0.0000	5	0.4507	0	0.0000	5	0.4507	0	0.0000	0	0.0000	0	0.0000
JATO Bottles	3.6067	7.2134	5	0.0008	70	0.0116	0	0.0000	5	0.0008	0	0.0000	5	0.0008	0	0.0000	0	0.0000	0	0.0000
Total			***388,801***	***25.8415***	***1,419,247***	***64.7404***	***378,955***	***24.3641***	***485,354***	***35.4361***	***388,093***	***25.4225***	***481,560***	***26.8777***	***2,579***	***0.0900***	***3,368***	***0.4984***	***36,974***	***0.3285***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.^{2}=square feet; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes

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Table F-17: Number and Impacts* of Military Expended Materials Proposed for Use During Testing Activities in a Five Years with Differences between Alternatives 1 and 2

			Range Complex												Testing Ranges					
			Northeast		VACAPES		Navy Cherry Point		JAX		Key West		GOMEX		NUWC Newport		SFOMF		NSWC Panama City	
Military Expended Materials	*Size (ft.^{2})*	*Impact Footprint (ft.^{2})*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Alternative 1																				
Other																				
Medium-Caliber (Explosive)	0.056	0.2239	19,300	0.0992	80,350	0.4130	16,800	0.0864	62,300	0.3202	16,800	0.0864	16,800	0.0864	0	0.0000	0	0.0000	0	0.0000
Medium Caliber (Non-Explosive)	0.056	0.2239	45,300	0.2328	1,155,325	5.9384	40,800	0.2097	1,150,800	5.9152	163,300	0.8394	114,300	0.5875	0	0.0000	0	0.0000	25,500	0.1311
Missiles (Explosive)	37.6691	74.7228	50	0.0858	1,033	1.7720	0	0.0000	327	0.5609	0	0.0000	30	0.0515	0	0.0000	0	0.0000	0	0.0000
Missiles (Non-Explosive)	14.1771	28.3543	122	0.0794	3,962	2.5790	122	0.0794	814	0.5299	157	0.1022	207	0.1347	0	0.0000	0	0.0000	0	0.0000
Rockets (Explosive)	0.7987	1.5974	0	0.0000	900	0.0330	0	0.0000	800	0.0293	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Rockets (Non-Explosive)	0.7987	1.5974	5	0.0002	3,713	0.1362	0	0.0000	1,950	0.0715	0	0.0000	5	0.0002	0	0.0000	0	0.0000	0	0.0000
Rockets (Non-Explosive): Flechette	0.7987	1.5974	0	0.0000	1,215	0.0446	0	0.0000	648	0.0238	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Targets																				
Surface Target (Mobile)	5.7522	11.5034	5	0.0013	763	0.2015	0	0.0000	96	0.0254	11	0.0029	11	0.0029	2,250	0.5942	0	0.0000	0	0.0000
Surface Target (Stationary)	96.8752	193.7504	858	3.8163	4,015	17.8583	858	3.8163	2,576	11.4578	890	3.9586	1,212	5.3909	2,421	10.7684	282	1.2543	0	0.0000
Subsurface Target (Mobile)	1.2206	2.4413	198	0.0111	237	0.0133	32	0.0018	867	0.0486	15	0.0008	983	0.0551	2,581	0.1447	0	0.0000	0	0.0000
Mine Shapes -Expended	25.7903	51.5807	0	0.0000	536	0.6347	0	0.0000	610	0.7223	0	0.0000	1,158	1.3712	0	0.0000	200	0.2368	1,815	2.1492
Countermeasures																				
Anti-Torpedo Torpedo	4.524	9.0847	330	0.0688	432	0.0901	180	0.0375	448	0.0934	0	0.0000	312	0.0651	0	0.0000	0	0.0000	0	0.0000
Other																				
ANMS Neutralizer (Explosive)	1.6286	3.2572	0	0.0000	1,090	0.0815	0	0.0000	250	0.0187	0	0.0000	500	0.0374	0	0.0000	0	0.0000	1,584	0.1184
Anchor - Mine	6.2495	12.5001	0	0.0000	10	0.0029	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	20	0.0057
Expended Bathythermograph	0.2771	0.5554	105,516	1.3454	48,667	0.6205	1,385	0.0177	2,775	0.0354	50	0.0006	49,063	0.6256	0	0.0000	20	0.0003	0	0.0000
Buoy (Non-Explosive)	0.97521	3.8987	1,077	0.0964	1,082	0.0968	617	0.0552	1,052	0.0942	2,007	0.1796	557	0.0499	0	0.0000	0	0.0000	0	0.0000
Fiber Optic Can	0.0011	0.0022	0	0.0000	1,090	0.0001	0	0.0000	250	0.0000	0	0.0000	500	0.0000	0	0.0000	0	0.0000	1,584	0.0001
Anti-Torpedo Torpedo Accessories	1.1011	2.0215	330	0.0153	432	0.0200	180	0.0084	448	0.0208	0	0.0000	312	0.0145	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo Accessories	0.1615	3.2367	421	0.0313	591	0.0439	210	0.0156	579	0.0430	10	0.0007	371	0.0276	100	0.0074	29	0.0022	0	0.0000
Lightweight Torpedo Accessories	1.1011	2.0215	267	0.0124	867	0.0402	247	0.0115	981	0.0455	7	0.0003	267	0.0124	100	0.0046	0	0.0000	960	0.0446
Sonobuoys (Non-Explosive)	1.2207	2.4413	15,911	0.8917	24,329	1.3635	10,606	0.5944	27,845	1.5606	14,807	0.8299	9,550	0.5352	6,000	0.3363	160	0.0090	960	0.0538
Mines (Explosive)	25.7903	51.5807	0	0.0000	10	0.0118	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	20	0.0237
Decelerator/Parachute - Small	9.0417	18.0834	16,116	6.6904	25,180	10.4532	10,811	4.4881	28,718	11.9219	14,812	6.1490	9,755	4.0497	6,000	2.4908	160	0.0664	960	0.3985
		Total	***1,355,829***	***42.4485***	***82,848***	***9.4219***	***1,285,134***	***33.5383***	***212,866***	***12.1505***	***205,893***	***13.0975***	***19,452***	***14.3464***	***851***	***1.5689***	***33,403***	***2.9251***	***1,355,829***	***42.4485***
Alternative 2																				
Projectiles																				
Medium-Caliber (Explosive)	0.056	0.2239	19,300	0.0992	86,350	0.4438	16,800	0.0864	74,300	0.3819	16,800	0.0864	16,800	0.0864	0	0.0000	0	0.0000	0	0.0000
Medium Caliber (Non-Explosive)	0.056	0.2239	45,300	0.2328	1,173,325	6.0309	40,800	0.2097	1,186,800	6.1002	163,300	0.8394	114,300	0.5875	0	0.0000	0	0.0000	25,500	0.1311
Missiles (Explosive)	37.6691	74.7228	50	0.0858	1,110	1.9041	0	0.0000	350	0.6004	0	0.0000	60	0.1029	0	0.0000	0	0.0000	0	0.0000
Missiles (Non-Explosive)	14.1771	28.3543	122	0.0794	3,994	2.5998	122	0.0794	822	0.5351	157	0.1022	207	0.1347	0	0.0000	0	0.0000	0	0.0000
Rockets (Explosive)	0.7987	1.5974	0	0.0000	1,030	0.0378	0	0.0000	1,000	0.0367	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000
Rockets (Non-Explosive)	0.7987	1.5974	5	0.0002	3,797	0.1392	0	0.0000	2,034	0.0746	0	0.0000	5	0.0002	0	0.0000	0	0.0000	0	0.0000
Rockets (Non-Explosive): Flechette	0.7987	1.5974	0	0.0000	1,243	0.0456	0	0.0000	676	0.0248	0	0.0000	0	0.0000	0	0.0000	0	0.0000		0.0000
Targets																				
Surface Target (Mobile)	5.7522	11.5034	5	0.0013	764	0.2018	0	0.0000	97	0.0256	11	0.0029	11	0.0029	2,250	0.5942	0	0.0000	0	0.0000
Surface Target (Stationary)	96.8752	193.7504	858	3.8163	4,160	18.5033	858	3.8163	2,727	12.1294	890	3.9586	1,242	5.5243	2,421	10.7684	282	1.2543	0	0.0000
Subsurface Target (Mobile)	1.2206	2.4413	272	0.0152	290	0.0163	40	0.0022	917	0.0514	15	0.0008	1,040	0.0583	2,581	0.1447	0	0.0000	0	0.0000
Mine Shapes -Expended	25.7903	51.5807	0	0.0000	636	0.7531	0	0.0000	610	0.7223	0	0.0000	1,158	1.3712	0	0.0000	200	0.2368	1,850	2.1906

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Table F-17: Number and Impacts* of Military Expended Materials Proposed for Use During Testing Activities in a Five Years with Differences between Alternatives 1 and 2 (continued)

Military Expended Materials	Size (ft.^{2})	Impact Footprint (ft.^{2})	*Range Complex*												*Testing Ranges*					
			Northeast		*VACAPES*		*Navy Cherry Point*		*JAX*		*Key West*		*GOMEX*		*NUWC Newport*		*SFOMF*		*NSWC Panama City*	
			Number	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*	*Number*	*Impact (Acre)*
Countermeasures																				
Anti-Torpedo Torpedo	4.524	9.0847	378	0.0788	480	0.1001	180	0.0375	496	0.1034	0	0.0000	360	0.0751	0	0.0000	0	0.0000	0	0.0000
Other																				
ANMS Neutralizer (Explosive)	1.6286	3.2572	0	0.0000	1,275	0.0953	0	0.0000	250	0.0187	0	0.0000	500	0.0374	0	0.0000	0	0.0000	1,665	0.1245
Anchor - Mine	6.2495	12.5001	0	0.0000	35	0.0100	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	45	0.0129
Expended Bathythermograph	0.2771	0.5554	105,516	1.3454	48,697	0.6209	1,385	0.0000	2,805	0.0358	50	0.0006	49,063	0.6256	0	0.0000	20	0.0003	0	0.0000
Buoy (Non-Explosive)	0.97521	3.8987	1,287	0.1152	1,107	0.0991	656	0.0000	1,177	0.1053	2,037	0.1823	632	0.0566	0	0.0000	0	0.0000	0	0.0000
Fiber Optic Can	0.0011	0.0022	0	0.0000	1,275	0.0001	0	0.0000	250	0.0000	0	0.0000	500	0.0000	0	0.0000	0	0.0000	1,665	0.0001
Anti-Torpedo Torpedo Accessories	1.1011	2.0215	378	0.0175	480	0.0223	180	0.0000	496	0.0230	0	0.0000	360	0.0167	0	0.0000	0	0.0000	0	0.0000
Heavyweight Torpedo Accessories	0.1615	3.2367	469	0.0348	639	0.0475	210	0.0156	627	0.0466	10	0.0007	419	0.0311	100	0.0074	29	0.0022	0	0.0000
Lightweight Torpedo Accessories	1.1011	2.0215	267	0.0124	1,110	0.0515	247	0.0000	981	0.0455	7	0.0003	267	0.0124	100	0.0046	0	0.0000	960	0.0446
Sonobuoys (Non-Explosive)	1.2207	2.4413	18,375	1.0298	27,740	1.5547	10,935	0.0000	29,910	1.6763	15,035	0.8426	10,135	0.5680	6,000	0.3363	160	0.0090	960	0.0538
Mines (Explosive)	25.7903	51.5807	0	0.0000	35	0.0414	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	45	0.0533
Decelerator/Parachute - Small	9.0417	18.0834	18,580	7.7133	28,762	11.9402	11,140	0.0000	30,852	12.8078	15,310	6.3558	10,340	4.2925	6,000	2.4908	160	0.0664	960	0.3985
		Total	***211,162***	***14.6775***	***1,388,334***	***45.2587***	***83,553***	***4.2472***	***1,338,177***	***35.5449***	***213,622***	***12.3727***	***207,399***	***13.5838***	***19,452***	***14.3464***	***851***	***1.5689***	***33,650***	***3.0094***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; AMNS = Airborne Mine Neutralization System; ft.^{2}=square feet; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2.

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Table F-18: Number of Recovered Materials Proposed for Use During Testing Activities in a Single Year Under Alternatives 1 and 2

	Range Complexes						*Testing Ranges*		
	Northeast	***VACAPES***	***Navy Cherry Point***	***JAX***	***Key West***	***GOMEX***	***NUWC Newport***	***SFOMF***	***NSWC Panama City***
Recovered Materials	***Number***	***Number***	***Number***	***Number***	***Number***	***Number***	***Number***	***Number***	***Number***
Other									
Air-Launched Lightweight Torpedo (Non-Explosive)	33	198	33	174	1	33	0	0	0
Heavyweight Torpedo (Non-Explosive)	97	127	42	133	1	83	125	6	0
Surface-Launched Lightweight Torpedo (Non-Explosive)	17	50	45	63	1	17	190	0	180
Targets									
Air Targets (Decoy)	0	26	0	0	0	0	0	0	0
Air Targets (Drone)	134	324	144	152	129	138	1,008	33	33
Surface Targets (Mobile)	314	562	306	481	325	325	462	12	12
Surface Targets (Stationary)	37	223	37	95	38	98	520	81	36
Subsurface Target (Mobile)	29	35	4	300	0	168	516	95	0
Subsurface Target (Mobile)	12,480	6,240	3,120	9,427	0	3,220	344	84	0
Total	***13,141***	***7,785***	***3,731***	***10,825***	***495***	***4,082***	***3,165***	***311***	***261***

Note: AMNS/EMNS = Airborne Mine Neutralization System/Expendable Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport;
SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes

Table F-19: Number and Impacts* of Recovered Bottom Placed Materials Proposed for Use During Testing Activities in a Single Year Under Alternatives 1 and 2

			Range Complexes												*Testing Ranges*					
			Northeast		***VACAPES***		***Navy Cherry Point***		***JAX***		***Key West***		***GOMEX***		***NUWC Newport***		***SFOMF***		***NSWC Panama City***	
Recovered Materials	***Size (ft.²)***	***Impact Footprint (ft.²)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***	***Number***	***Impact (Acre)***
Anchor -Other	3.1248	6.2495	3,600	0.5165	1,800	0.2582	0	0.0000	100	0.0143	0	0.0000	1,916	0.2749	170	0.0244	15	0.0022	0	0.0000
Bottom Placed Instruments	2.0000	4.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	600	0.0551	0	0.0000	0	0.0000
Mine Shape (Non-explosive)	25.7903	51.5807	0	0.0000	1,148	1.3594	1,200	1.4210	22,271	26.3718	0	0.0000	1,633	1.9337	1,167	1.3819	845	1.0006	31,686	37.5203
Total			***3,600***	***0.5165***	***2,948***	***1.6176***	***1,200***	***1.4210***	***22,371***	***26.3861***	***0***	***0.0000***	***3,549***	***2.2086***	***1,937***	***1.4614***	***860***	***1.0027***	***31,686***	***37.5203***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; ft.²=square feet; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes

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Table F-20: Number of Recovered Materials Proposed for Use During Testing Activities in Five Years Under Alternatives 1 and 2

Recovered Materials		Range Complexes: Northeast	Range Complexes: VACAPES	Range Complexes: Navy Cherry Point	Range Complexes: JAX	Range Complexes: Key West	Range Complexes: GOMEX	Testing Ranges: NUWC Newport	Testing Ranges: SFOMF	Testing Ranges: NSWC Panama City
		Number	Number	Number	Number	Number	Number	Number	Number	Number
Other										
Air-Launched Lightweight Torpedo (Non-Explosive)	Alternative 1	163	737	163	791	3	163	0	0	0
	Alternative 2		980		860					
Heavyweight Torpedo (Non-Explosive)	Alternative 1	416	586	206	575	6	366	625	29	0
	Alternative 2	464	634		623		414			
Surface-Launched Lightweight Torpedo (Non-Explosive)		82	248	222	307	2	82	950	0	900
Targets										
Air Target (Decoy)		0	132	0	0	0	0	0	0	0
Air Target (Drone)		614	1,565	669	707	590	638	4,988	113	113
Surface Target (Mobile)	Alternative 1	1,549	2,790	1,509	2,375	1,603	1,603	2,289	39	39
	Alternative 2				2,382					
Surface Target (Stationary)		131	583	131	424	134	437	2,545	350	124
Subsurface Target (Mobile)	Alternative 1	145	175	20	1,495	0	838	2,581	475	0
	Alternative 2				1,497					
Subsurface Target (Stationary)		62,400	31,200	15,600	47,133	0	16,102	1,718	419	0
Total	***Alternative 1***	***65,500***	***38,016***	***18,520***	***53,500***	***2,338***	***20,229***	***15,696***	***1,425***	***1,176***
	Alternative 2	***65,548***	***38,307***		***53,933***		***20,277***			

Note: AMNS=Airborne Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2.

Table F-21: Number and Impacts* of Recovered Bottom Placed Materials Proposed for Use During Testing Activities in Five Years as Part of Alternatives 1 and 2

Recovered Materials		Size ($ft.^2$)	Impact Footprint ($ft.^2$)	Northeast Number	Northeast Impact (Acre)	VACAPES Number	VACAPES Impact (Acre)	Navy Cherry Point Number	Navy Cherry Point Impact (Acre)	JAX Number	JAX Impact (Acre)	Key West Number	Key West Impact (Acre)	GOMEX Number	GOMEX Impact (Acre)	NUWC Newport Number	NUWC Newport Impact (Acre)	SFOMF Number	SFOMF Impact (Acre)	NSWC Panama City Number	NSWC Panama City Impact (Acre)
Anchor -Other		3.1248	6.2495	18,000	2.5824	9,000	1.2912	0	0.0000	501	0.0719	0	0.0000	9,576	1.3739	851	0.1221	75	0.0108	0	0.0000
Bottom Placed Instruments		2.0000	4.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	0	0.0000	3,000	0.2755	0	0.0000	0	0.0000
Mine Shape (Non-explosive)	Alternative 1	25.7903	51.5807	0	0.0000	5,151	6.0995	6,000	7.1048	83,994	99.4598	0	0.0000	8,164	9.6672	5,354	6.3398	4,223	5.0006	115,389	136.6356
	Alternative 2					5,739	6.7957													115,878	137.2146
Total	***Alternative 1***			***18,000***	***2.5824***	***14,151***	***7.3907***	***6,000***	***7.1048***	***84,495***	***99.5317***	***0***	***0.0000***	***17,740***	***11.0411***	***9,205***	***6.7374***	***4,298***	***5.0113***	***115,389***	***136.6356***
	Alternative 2					***14,739***	***8.0869***													***115,878***	***137.2146***

Note: * Calculation for "Impact (Acre)" Column = ([Impact Footprint] x [Number]) / 43560
ac=acre; $ft.^2$=square feet; GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC Panama City=Naval Surface Warfare Center Panama City; NUWC Newport=Naval Undersea Warfare Center Newport; SFOMF=South Florida Ocean Measurement Facility; VACAPES=Virginia Capes
Blue shading indicatesnumbers and impacts of MEM that differ between Alternatives 1 and 2.

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F.2 IMPACTS TO ABIOTIC SUBSTRATE – TRAINING AND TESTING ACTIVITIES

Table F-22 through Table F-34 show impacts to abiotic substrate within the AFTT Study Area for both Single Year and Five Year totals.

Table F-22: Potential Impact from Explosives On or Near the Bottom for Training Activities Under Alternative 1 and 2 in a Single Year

Training Areas	*Net Explosive Weight (lb.)*	*Number of Charges*	*Total Impact Footprint (Acre)*	*Hard Substrate*		*Intermediate Substrate*		*Soft substrate*		*Unknown substrate*	
				Acre	*% Impact*	*Acre*	*% Impact*	*Acre*	*% Impact*	*Acre*	*% Impact*
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
VACAPES RC	5	8	0.0534	559,734	0.000010	1,874,186	0.000003	22,262,693	0.000000	N/A	
	10	224	2.3524		0.000420		0.000126		0.000011		
	20	288	4.8037		0.000858		0.000256		0.000022		
	60	4	0.1389		0.000025		0.000007		0.000001		
	AMNS Neutralizer	62	0.3064		0.000055		0.000016		0.000001		
		Total	***7.6548***		***0.001382***		***0.001368***		***0.0004084***		
Northeast U.S. Continental Shelf Large Marine Ecosystem											
Lower Chesapeake Bay	5	12	0.0801	0	0	2,134	0.003752	362,740	0.000022	445	0.0179910
		Total	***0.0801***		***0***		***0.003752***		***0.000022***		***0.0179910***
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem											
Navy Cherry Point RC	5	4	0.0267	1,081,358	0.000002	214,657	0.0000124	14,611,417	0.0000002	N/A	
	20	12	0.0667		0.000006		0.0000311		0.0000005		
	AMNS Neutralizer	1	0.0049		0.000000		0.0000023		0.0000000		
		Total	***0.098270***		***0.000009***		***0.0000458***		***0.0000007***		
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
JAX RC	0.5	2	0.0030	9,306,697	0.0000000	6,530,477	0.0000000	26,485,602	0.0000000	0.083623	3.5456443
	5	4	0.0267		0.0000003		0.0000004		0.0000001		31.928736
	10	8	0.0840		0.0000009		0.0000013		0.0000003		100.44995
	20	8	0.1334		0.0000014		0.0000020		0.0000005		159.52409
	AMNS Neutralizer	2	0.0099		0.0000001		0.0000002		0.0000000		11.819611
		Total	***0.256949***		***0.0000028***		***0.0000039***		***0.0000010***		***307.268044***

Table F-22: Potential Impact from Explosives On or Near the Bottom for Training Activities Under Alternative 1 and 2 in a Single Year (continued)

Training Areas	*Net Explosive Weight (lb.)*	*Number of Charges*	*Total Impact Footprint (Acre)*	*Hard Substrate*		*Intermediate Substrate*		*Soft substrate*		*Unknown substrate*	
				Acre	*% Impact*	*Acre*	*% Impact*	*Acre*	*% Impact*	*Acre*	*% Impact*
Caribbean and Gulf of Mexico Large Marine Ecosystem											
Key West RC	5	14	0.0934	4,493,152	0.0000021	1,472,965	0.0000063	14,163,039	0.0000007	1,324,082	0.0000071
	10	4	0.0420		0.0000009		0.0000029		0.0000003		0.0000032
	20	4	0.0667		0.0000015		0.0000045		0.0000005		0.0000050
		Total	***0.202100***		***0.0000045***		***0.0000137***		***0.0000014***		***0.0000153***
Gulf of Mexico Large Marine Ecosystem											
GOMEX RC	0.5	2	0.0030	2,955,100	0.0000001	3,418,643	0.0000001	56,370,160	0.0000000	971	0.0003054
	5	4	0.0267		0.0000009		0.0000008		0.0000000		0.0027497
	10	4	0.0420		0.0000014		0.0000012		0.0000001		0.0043254
	20	8	0.1334		0.0000045		0.0000039		0.0000002		0.0137384
	AMNS Neutralizer	22	0.1087		0.0000037		0.0000032		0.0000002		0.0111977
		Total	***0.313795***		***0.0000106***		***0.0000092***		***0.0000006***		***0.0111977***

Note: ac=acre; AMNS=Airborne Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; lb.=pounds; RC=Range Complex; VACAPES=Virginia Capes

Table F-23: Potential Impact from Explosives On or Near the Bottom for Testing Activities Under Alternative 1 in a Single Year

				Hard Substrate		*Intermediate Substrate*		*Soft substrate*		*Unknown substrate*	
Training Areas	***Net Explosive Weight (lb.)***	***Number of Charges***	***Total Impact Footprint (Acre)***	***Acre***	***% Impact***	***Acre***	***% Impact***	***Acre***	***% Impact***	***Acre***	***% Impact***
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
VACAPES RC	650	2	0.3398	559,734	0.0000607	1,874,186	0.0000181	22,262,693	0.0000015	N/A	
	AMNS Neutralizer	250	1.2355		0.0002207		0.0000659		0.0000055		
		Total	***1.5753***		***0.0002814***		***0.0000841***		***0.0000071***		
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
JAX RC	AMNS Neutralizer	50	0.2471	9,306,697	0.0000027	6,530,477	0.0000038	26,485,602	0.0000009	0.08362373	295.49626
		Total	***0.2471***		***0.0000027***		***0.0000038***		***0.0000009***		***295.4962664***
Gulf Of Mexico Large Marine Ecosystem											
GOMEX RC	AMNS Neutralizer	100	0.4942	2,955,100	0.0000167	3,418,643	0.0000145	56,370,160	0.0000009	971	0.0508971
		Total	***0.4942***		***0.0000167***		***0.0000145***		***0.0000009***		***0.0508971***
NSWC Panama City Testing Range	650	4	0.6795	1,260,458	0.0000539	2,368,180	0.0000287	15,776,970	0.0000043	224	0.3033661
	AMNS Neutralizer	328	1.6201		0.0001285		0.0000684		0.0000103		0.7232594
	Line Charge	4	4.2739		0.0003391		0.00018047		0.0000271		1.9080063
		Total	***6.5736***		***0.0005215***		***0.0002776***		***0.0000417***		***2.6312656***

Note: ac=acre; AMNS=Airborne Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; lb.=pounds; NSWC Panama City=Naval Surface Warfare Center Panama City; RC=Range Complex; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-24: Potential Impact from Explosives On or Near the Bottom for Testing Activities Under Alternative 2 in a Single Year

Training Areas	Net Explosive Weight (lb.)	Number of Charges	Total Impact Footprint (Acre)	Hard Substrate		Intermediate Substrate		Soft substrate		Unknown Substrate	
				Acre	% Impact	Acre	% Impact	Acre	% Impact	Acre	% Impact
Northeast U.S. Continental Shelf Large Marine Ecosystem											
VACAPES RC	650	7	1.1892	559,734	0.0002125	1,874,186	0.0001635	21,573,934	0.0000055	N/A	
	AMNS Neutralizer	255	1.2602		0.0002251		0.0000672		0.0000058		
Total			***2.4494***		***0.0004376***		***0.0001307***		***0.0000114***		
Southeast U.S. Continental Shelf Large Marine Ecosystem											
JAX RC	AMNS Neutralizer	50	0.2471	9,306,697	0.0000027	6,530,477	0.0000038	26,485,602	0.0000009	0.08362373	295.4967
Total			***0.2471***		***0.0000027***		***0.0000038***		***0.0000009***		***295.4967***
Gulf Of Mexico Large Marine Ecosystem											
GOEMX RC	AMNS Neutralizer	100	0.4942	2,955,100	0.0000167	3,418,643	0.0000145	56,370,160	0.0000009	971	0.0508971
Total			***0.4942***		***0.0001087***		***0.0000145***		***0.0000009***		***0.0508971***
NSWC Panama City Testing Range	650	9	1.5290	1,260,458	0.0001213	2,368,180	0.0000646	15,776,970	0.0000097	224	0.6825732
	AMNS Neutralizer	333	1.6457		0.0001306		0.0000695		0.0000104		0.7346875
	Line Charge	4	4.2739		0.0003391		0.0001805		0.0000271		1.9079911
Total			***13.8733***		***0.0005909***		***0.0003145***		***0.0000472***		***3.3252518***

Note: ac=acre; AMNS=Airborne Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; lb.=pounds; NSWC Panama City=Naval Surface Warfare Center Panama City; RC=Range Complex; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-25: Potential Impact from Explosives On or Near the Bottom for Training Activities under Alternatives 1 and 2 Over Five Years

Training Areas	Net Explosive Weight (lb.)	Number of Charges	Total Impact Footprint (Acre)	Hard Substrate		Intermediate Substrate		Soft substrate		Unknown Substrate	
				Acre	% Impact	Acre	% Impact	Acre	% Impact	Acre	% Impact
Alternative 1											
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
VACAPES RC	5	40	0.2669	559,734	0.0000477	1,874,186	0.0000142	22,262,693	0.0000012	N/A	
	10	1,120	11.7622		0.0021014		0.0006276		0.0000528		
	20	1,440	24.0186		0.0042911		0.0012815		0.0001079		
	60	20	0.6944		0.0001241		0.0000371		0.0000031		
	AMNS Neutralizer	306	1.5123		0.0002702		0.0000807		0.0000068		
		Total	***38.2544***		***0.0068344***		***0.0020411***		***0.0001718***		
Northeast U.S. Continental Shelf Large Marine Ecosystem											
Lower Chesapeake Bay	5	60	0.4003	0	0	2,134	0.0187582	362,740	0.0001104	445	0.0899551
		Total	***0.4003***		***0***		***0.0187582***		***0.0001104***		***0.0899551***
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem											
Navy Cherry Point RC	5	20	0.1334	1,081,358	0.000012	214,657	0.0000621	14,611,417	0.0000009	N/A	
	20	60	1.0008		0.000093		0.0004662		0.0000068		
	AMNS Neutralizer	5	0.0247		0.000002		0.0000115		0.0000002		
		Total	***1.235500***		***0.000107***		***0.0005399***		***0.0000079***		
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
JAX RC	0.5	6	0.0089	9,306,697	0.0000001	6,530,477	0.0000001	26,485,602	0.0000000	0.0836237	10.6429120
	5	20	0.1334		0.0000014		0.0000020		0.0000005		159.5240968
	10	40	0.4201		0.0000045		0.0000064		0.0000016		502.3693633
	20	40	1.0008		0.0000072		0.0000102		0.0000025		797.8596506
	AMNS Neutralizer	6	0.0297		0.0000003		0.0000005		0.0000001		35.5162344
		Total	***1.459500***		***0.0000135***		***0.0000193***		***0.0000048***		***1,505.9122***

Table F-25: Potential Impact from Explosives On or Near the Bottom for Training Activities under Alternatives 1 and 2 Over Five Years (continued)

Training Areas	Net Explosive Weight (lb.)	Number of Charges	Total Impact Footprint (Acre)	Hard Substrate		Intermediate Substrate		Soft substrate		Unknown Substrate	
				Acre	% Impact	Acre	% Impact	Acre	% Impact	Acre	% Impact
Caribbean and Gulf of Mexico Large Marine Ecosystem											
Key West RC	5	70	0.4671	4,493,152	0.0000104	1,472,965	0.0000317	14,163,039	0.0000033	1,324,082	0.0000353
	10	20	0.2100		0.0000047		0.0000143		0.0000015		0.0000159
	20	20	0.3360		0.0000075		0.0000228		0.0000024		0.0000254
		Total	***1.013100***		***0.0000225***		***0.0000688***		***0.0000072***		***0.0000765***
Gulf of Mexico Large Marine Ecosystem											
GOMEX RC	0.5	6	0.0089	2,955,100	0.0000003	3,418,643	0.0000003	56,370,160	0.0000000	971	***0.1595572***
	5	20	0.1334		0.0000045		0.0000039		0.0000002		***0.1595572***
	10	20	0.2100		0.0000071		0.0000061		0.0000004		***0.1595572***
	20	40	0.6672		0.0000226		0.0000195		0.0000012		***0.1595572***
	AMNS Neutralizer	106	0.5239		0.0000177		0.0000153		0.0000009		***0.1595572***
		Total	***1.543400***		***0.000052***		***0.0000451***		***0.0000027***		***0.1595572***
Alternative 2											
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
VACAPES RC	5	40	0.2669%	559,734	0.0000477	1,874,186	0.0000142	22,262,693	0.0000012	N/A	
	10	1,120	11.7622		0.0021014		0.0006276		0.0000528		
	20	1,440	24.0186		0.0042911		0.0012815		0.0001079		
	60	20	0.6944		0.0001241		0.0000371		0.0000031		
	AMNS Neutralizer	306	1.5123		0.0002702		0.0000807		0.0000068		
		Total	***38.2544***		***0.0068344***		***0.0020411***		***0.0001718***		
Northeast U.S. Continental Shelf Large Marine Ecosystem											
Lower Chesapeake Bay	5	60	0.4003	0	0	2,134	0.0187582	362,740	0.0001104	445	0.0899551
		Total	***0.4003***		***0***		***0.0187582***		***0.0001104***		***0.0899551***

Table F-25: Potential Impact from Explosives On or Near the Bottom for Training Activities under Alternatives 1 and 2 Over Five Years (continued)

Training Areas	Net Explosive Weight (lb.)	Number of Charges	Total Impact Footprint (ac)	Hard Substrate		Intermediate Substrate		Soft substrate		Unknown Substrate	
				Acre	% Impact	Acre	% Impact	Acre	% Impact	Acre	% Impact
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem											
Navy Cherry Point RC	5	20	0.1334		0.000012		0.0000621		0.0000009		
	20	60	1.0008		0.000093		0.0004662		0.0000068		
	AMNS Neutralizer	5	0.0247	1,081,358	0.000002	214,657	0.0000115	14,611,417	0.0000002	N/A	
		Total	***1.158900***		***0.00007***		***0.0005399***		***0.0000079***		
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
JAX RC	0.5	10	0.0148		0.0000002		0.0000002		0.0000001		17.6983256
	5	20	0.1334		0.0000014		0.0000020		0.0000005		159.5240968
	10	40	0.4201	9,306,697	0.0000045	6,530,477	0.0000064	26,485,602	0.0000016	0.0836237	502.3693633
	20	40	0.6672		0.0000072		0.0000102		0.0000025		797.8596506
	AMNS Neutralizer	6	0.0297		0.0000003		0.0000005		0.0000001		35.5162344
		Total	***1.265200***		***0.0000136***		***0.0000194***		***0.0000048***		***1,512.9676***
Caribbean and Gulf of Mexico Large Marine Ecosystem											
Key West RC	5	70	0.4671		0.0000104		0.0000317		0.0000033		0.0000353
	10	20	0.2100	4,493,152	0.0000047	1,472,965	0.0000143	14,163,039	0.0000015	1,324,082	0.0000159
	20	20	0.3360		0.0000075		0.0000228		0.0000024		0.0000254
		Total	***1.013100***		***0.0000225***		***0.0000688***		***0.0000072***		***0.0000765***
Gulf of Mexico Large Marine Ecosystem											
GOMEX RC	0.5	10	0.0148		0.0000005		0.0000004		0.0000000		0.0015242
	5	20	0.1334		0.0000045		0.0000039		0.0000002		0.0137384
	10	20	0.2100	2,955,100	0.0000071	3,418,643	0.0000061	56,370,160	0.0000004	971	0.0216272
	20	40	0.6672		0.0000226		0.0000195		0.0000012		0.0687127
	AMNS Neutralizer	106	0.5239		0.0000177		0.0000153		0.0000009		0.0539547
		Total	***1.549300***		***0.0000524***		***0.0000453***		***0.0000027***		***0.1595572***

Note: ac=acre; AMNS=Airborne Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; lb.=pounds; RC=Range Complex; VACAPES=Virginia Capes

Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2.

Table F-26: Potential Impact from Explosives On or Near the Bottom for Testing Activities under Alternatives 1 and 2 Over Five Years

Testing Areas	*Net Explosive Weight (lb.)*	*Number of Charges*	*Total Impact Footprint (Acre)*	*Hard Substrate*		*Intermediate Substrate*		*Soft substrate*		*Unknown Substrate*	
				Acre	*% Impact*	*Acre*	*% Impact*	*Acre*	*% Impact*	*Acre*	*% Impact*
Alternative 1											
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
VACAPES RC	650	10	1.6988	559,734	0.0003035	1,874,186	0.0000906	22,262,693	0.0000076	N/A	
	AMNS Neutralizer	1,090	5.3869		0.0009624		0.0002874		0.0000242		
Total			***7.0857***		***0.0012659***		***0.0003781***		***0.0000318***		
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
JAX RC	AMNS Neutralizer	250	1.2355	9,306,697	0.0000133	6,530,477	0.0000189	28,485,62	0.0000047	0.0836237	1,477.451
		Total	***1.2355***		***0.0000133***		***0.0000189***		***0.0000047***		***1,477.451***
Gulf Of Mexico Large Marine Ecosystem											
GOMEX RC	AMNS Neutralizer	500	2.4711	2,955,100	0.0000836	3,418,643	0.0000723	56,370,160	0.0000044	971	0.2544851
		Total	***2.4711***		***0.0000836***		***0.0000723***		***0.0000044***		***0.2544851***
NSWC Panama City Testing Range	650	20	3.3977	1,260,458	0.0002696	2,368,180	0.0001435	15,776,970	0.0000215	224	1.5168304
	AMNS Neutralizer	1,584	7.8283		0.0006211		0.0003306		0.0000496		3.4947768
	Line Charge	20	21.3697		0.0016954		0.0009024		0.0001354		9.5400446
		Total	***32.5957***		***0.0025860***		***0.0013764***		***0.0002066***		***14.551652***
Alternative 2											
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone											
VACAPES RC	650	35	5.9456	559,734	0.0010622	1,874,186	0.0003172	22,262,693	0.0000267	N/A	
	AMNS Neutralizer	1275	6.3012		0.0011257		0.0003362		0.0000283		
		Total	***19.0426***		***0.0034021***		***0.0010160***		***0.0000855***		
Southeast U.S. Continental Shelf Large Marine Ecosystem											
JAX RC	AMNS Neutralizer	250	1.2355	9,306,697	0.0000133	6,530,477	0.0000189	28,485,62	0.0000047	0.0836237	1,477.451
		Total	***1.2355***		***0.0000133***		***0.0000189***		***0.0000047***		***1,477.451***

Table F-26: Potential Impact from Explosives On or Near the Bottom for Testing Activities under Alternatives 1 and 2 Over Five Years (continued)

Testing Areas	Net Explosive Weight (lb.)	Number of Charges	Total Impact Footprint (Acre)	Hard Substrate		Intermediate Substrate		Soft substrate		Unknown Substrate	
				Acre	% Impact	Acre	% Impact	Acre	% Impact	Acre	% Impact
Gulf Of Mexico Large Marine Ecosystem											
GOMEX RC	AMNS Neutralizer	500	2.4711	2,955,100	0.0000836	3,418,643	0.0000723	56,370,160	0.0000044	971	0.2544851
		Total	**2.4711**		***0.0000836***		***0.0000723***		***0.0000044***		***0.2544851***
NSWC Panama City Testing Range	650	45	7.6448	1,260,458	0.0006065	2,368,180	0.0003228	15,776,970	0.0000485	224	3.4128571
	AMNS Neutralizer	1,665	8.2286		0.0006528		0.0003475		0.0000522		3.6734821
	Line Charge	20	21.3697		0.0016954		0.0009024		0.0001354		9.5400446
		Total	***37.2431***		***0.0029547***		***0.0015726***		***0.0002361***		***16.62638***

Note: ac=acre; AMNS=Airborne Mine Neutralization System; GOMEX=Gulf of Mexico; JAX=Jacksonville; lb.=pounds; NSWC Panama City=Naval Surface Warfare Center Panama City; RC=Range Complex; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-27: Potential Impact of Military Expended Materials from Training Activities on Each Substrate Type in a Single Year

Training Areas	*Percent Impact to Hard Bottom*		*Percent Impact to Intermediate Bottom*		*Percent Impact to Soft Bottom*	
	Alternative 1	*Alternative 2*	*Alternative 1*	*Alternative 2*	*Alternative 1*	*Alternative 2*
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
Northeast RC	0.00006493	0.00006494	0.000025762	0.000025765	0.000005122	
VACAPES RC	0.0075159	0.0075172	0.0022446	0.0022451	0.00012257	
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem						
James River and Tributaries, VA	0		0.01434		0.0027481	
Lower Chesapeake Bay	0		0.002863		0.00001685	
York River, VA	0		0.00019588		0.000012257	
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem						
Navy Cherry Point RC	0.0013585	0.00103587	0.006843	0.006844	0.00010050	0.00010060
Cooper River, SC	0		0		0.00011270	
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
JAX RC	0.0004252	0.0004254	0.000606	0.000606	0.00014900	0.00014900
Port Canaveral, FL	0		0		0.00380165	
Caribbean and Gulf of Mexico Large Marine Ecosystems						
Key West RC	0.00008736		0.0002555		0.00002657	
Gulf of Mexico Large Marine Ecosystem						
GOMEX RC	0.000103	0.000112	0.0000867	0.0000965	0.00000526	0.00000580
Abyssal Zone						
Other AFTT Area	0.00009653		0.00006201		0.00000433	
SINKEX Area	0		0		0.00000011	

Note: GOMEX=Gulf of Mexico; JAX=Jacksonville; RC=Range Complex; SINKEX = Sinking Exercise; VACAPES=Virginia Capes
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-28: Potential Impact of Military Expended Materials from Testing Activities on Each Substrate Type in a Single Year

Testing Areas	*Percent Impact to Hard Bottom*		*Percent Impact to Intermediate Bottom*		*Percent Impact to Soft Bottom*	
	Alternative 1	*Alternative 2*	*Alternative 1*	*Alternative 2*	*Alternative 1*	*Alternative 2*
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
Northeast RC	0.00022622	0.00022855	0.00008975	0.00009068	0.00001785	0.00001803
VACAPES RC	0.00343850	0.00344346	0.00102692	0.00102841	0.00008645	0.00008658
Northeast U.S. Continental Shelf Large Marine Ecosystem						
NUWC Newport Testing Range	0.00145520		0.00017250		0.00003892	
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem						
Navy Cherry Point RC	0.00034316	0.00034509	0.00172870	0.00173840	0.00002540	0.00002554
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
JAX RC	0.00011128	0.00011239	0.00015859	0.00016017	0.00003910	0.00003949
Southeast U.S. Continental Shelf Large Marine Ecosystem						
SFOMF	0.00014342		0.01507990		0.00050836	
Caribbean and Gulf of Mexico Large Marine Ecosystems						
Key West RC	0.00009702		0.00029596		0.00003078	
Gulf of Mexico Large Marine Ecosystem						
GOMEX RC	0.00017477		0.00015107		0.00000916	
NSWC Panama City Testing Range	0.00005165	0.00005220	0.00002749	0.00002779	0.00000413	0.00000417

Note: GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; ; RC=Range Complex; SFOMF = South Florida Ocean Measurement Facility
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-29: Potential Impact of Military Expended Materials from Training Activities on Each Substrate Type over Five Years

Training Areas	Percent Impact to Hard Bottom		Percent Impact to Intermediate Bottom		Percent Impact to Soft Bottom	
	Alternative 1	Alternative 2	Alternative 1	Alternative 2	Alternative 1	Alternative 2
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
Northeast RC	0.00032466	0.00032469	0.00012881	0.00012882	0.00002561	
VACAPES RC	0.03756110	0.03758600	0.01121780	0.01122520	0.0009444	0.9449970
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem						
James River and Tributaries, VA	0		0.0717019		0.0137407	
Lower Chesapeake Bay	0		0.0143167		0.00008484	
York River, VA	0		0.00097943		0.000061287	
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem						
Navy Cherry Point RC	0.0067761	0.0067936	0.03413351	0.00342234	0.00501482	0.00050278
Cooper River, SC	0		0		0.00056343	
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
JAX RC	0.00211835	0.00212709	0.00301889	0.00303135	0.00074436	0.00074743
Port Canaveral, FL	0		0		0.01900820	
Caribbean and Gulf of Mexico Large Marine Ecosystems						
Key West RC	0.000418816		0.00127756		0.00013287	
Gulf of Mexico Large Marine Ecosystem						
GOMEX RC	0.00050173	0.00055826	0.00043370	0.00048256	0.00002630	0.00002927
Abyssal Zone						
Other AFTT Area	0.000047457		0.00003048		0.00000213	
SINKEX Area	0		0		0.00000053	

Note: GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; RC=Range Complex; SINKEX = Sinking Exercise
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-30: Potential Impact of Military Expended Materials from Testing Activities on Each Substrate Type over Five Years

Testing Areas	Percent Impact to Hard Bottom		Percent Impact to Intermediate Bottom		Percent Impact to Soft Bottom	
	Alternative 1	*Alternative 2*	*Alternative 1*	*Alternative 2*	*Alternative 1*	*Alternative 2*
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
Northeast RC	0.001083	0.001135	0.000430	0.000450	0.000085	0.000089
VACAPES RC	0.016657	0.017190	0.004975	0.005134	0.000419	0.000432
Northeast U.S. Continental Shelf Large Marine Ecosystem						
NUWC Newport Testing Range	0.007229		0.000857		0.000193	
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem						
Navy Cherry Point RC	0.001702	0.001716	0.008572	0.008646	0.000126	0.000127
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone						
JAX RC	0.000537	0.000559	0.000765	0.000796	0.000189	0.000196
Southeast U.S. Continental Shelf Large Marine Ecosystem						
SFOMF	0.000687		0.072179		0.002433	
Caribbean and Gulf of Mexico Large Marine Ecosystems						
Key West RC	0.000480	0.000483	0.001463	0.001473	0.000152	0.000153
Gulf of Mexico Large Marine Ecosystem						
GOMEX RC	0.000854	0.000871	0.000738	0.000752	0.000045	0.000046
NSWC Panama City Testing Range	0.000247	0.000253	0.000131	0.000135	0.000197	0.000020

Note GOMEX=Gulf of Mexico; JAX=Jacksonville; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; RC=Range Complex; SFOMF = South Florida Ocean Measurement Facility;
Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-31: Proportional Impact to Bottom Habitat from Training Activities Under Alternatives 1 and 2 in a Single Year

Training Areas		Impact to Hard Bottom		Impact to Intermediate Bottom		Impact to Soft Bottom		Impact to Unknown Bottom	
		MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
Northeast RC	Alternative 1	0.098433	0	0.248094	0	1.247814	0	0.00012372	0
	Alternative 2	0.098442		0.248112		1.247923		0.00012373	
VACAPES RC	Alternative 1	0.952110	0.173244	3.187990	0.580081	37.868830	6.890549	0	0
	Alternative 2	0.952280		3.188550		37.875480			
Northeast U.S. Continental Shelf Large Marine Ecosystem									
Lower Chesapeake Bay	Alternative 1	0	0	0.000337	0.000442	0.057306	0.075073	0.000070	0.000092
	Alternative 2								
James River and Tributaries	Alternative 1	0	0	0.354140	0	1.847980	0	0.048350	0
	Alternative 2								
York River, VA	Alternative 1	0	0	0.000095	0	0.001519	0	0.000013	0
	Alternative 2								
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem									
Navy Cherry Point	Alternative 1	0.997284	0.015735	0.197968	0.003124	13.475478	0.212612	0	0
	Alternative 2	0.997424		0.197996		13.477290			
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
JAX RC	Alternative 1	8.693468	0.056455	6.100176	0.039614	24.740434	0.160663	0	0
	Alternative 2	8.697558		6.103046		24.752074			
Cooper River, SC	Alternative 1	0	0	0	0	0.000805	0	0.002288	0
	Alternative 2								
Port Canaveral, FL	Alternative 1	0	0	0	0	0.008452	0	0.005535	
	Alternative 2								
Caribbean and Gulf of Mexico Large Marine Ecosystems									
Key West	Alternative 1	0.787791	0.042310	0.258257	0.013870	2.483225	0.133367	0.232153	0.012468
	Alternative 2								
Gulf of Mexico Large Marine Ecosystem									
GOMEX	Alternative 1	0.139264	0.014738	0.161109	0.017050	2.656541	**0.281137**	0.000046	0.000005
	Alternative 2	0.154953		0.179259		2.955825		0.000051	
Abyssal Zone									
Other AFTT	Alternative 1	0.007712	0	0.012006	0	0.1719333	0	1.177579	0
	Alternative 2								
SINKEX Area	Alternative 1	0	0	0	0	0.034267	0	0.014862	0
	Alternative 2								

Note: ac=acre; GOMEX=Gulf of Mexico; JAX=Jacksonville; MEM = Military Expended Materials; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; RC=Range Complex; SINKEX = Sinking Exercise

Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-32: Proportional Impact to Bottom Habitat from Testing Activities Under Alternatives 1 and 2 in a Single Year

Training Areas		*Impact to Hard Bottom*		*Impact to Intermediate Bottom*		*Impact to Soft Bottom*		*Impact to Unknown Bottom*	
		MEM Footprint (ac)	*Explosive Footprint (ac)*	*MEM Footprint (ac)*	*Explosive Footprint (ac)*	*MEM Footprint (ac)*	*Explosive Footprint (ac)*	*MEM Footprint (ac)*	*Explosive Footprint (ac)*
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
Northeast RC	Alternative 1	0.342933	0	0.864339	0	4.347285	0	0.000431	0
	Alternative 2	0.346475		0.873266		4.392187		0.000436	
VACAPES RC	Alternative 1	0.435586	0.035652	1.458493	0.119376	17.324844	1.418014	0	0
	Alternative 2	0.436214	0.055436	1.460598	0.185617	17.349847	2.204873		
Northeast U.S. Continental Shelf Large Marine Ecosystem									
NUWC Newport Testing Range	Alternative 1	0.063395	0	0.534798	0	2.370474	0	0.017550	0
	Alternative 2								
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem									
Navy Cherry Point RC	Alternative 1	0.251914	0	0.050007	0	3.403885	0	0	0
	Alternative 2	0.253324		0.050286		3.422932			
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
JAX RC	Alternative 1	2.275096	0.054284	1.596426	0.038091	6.474615	0.154484	0.000000	0.000000
	Alternative 2	2.297848		1.612392		6.539364		0.000000	
Southeast U.S. Continental Shelf Large Marine Ecosystem									
SFOMF	Alternative 1	0.350173	0	0.003331	0	0.098796	0	0.000012	0
	Alternative 2								
Caribbean and Gulf of Mexico Large Marine Ecosystems									
Key West RC	Alternative 1	0.912499	0	0.299139	0	2.876322	0	0.268903	0
	Alternative 2								
Gulf of Mexico Large Marine Ecosystem									
GOMEX RC	Alternative 1	0.242548	0.023210	0.280594	0.026850	4.626728	0.442735	0.000080	0.000008
	Alternative 2								
NSWC Panama City Testing Range	Alternative 1	0.042075	0.424939	0.079052	0.798385	0.526652	5.318893	0.000007	0.000075
	Alternative 2	0.042529	0.481438	0.079904	0.904537	0.532325	6.026086		0.000085

Note: ac=acre; GOMEX=Gulf of Mexico; JAX=Jacksonville; MEM = Military Expended Materials; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; RC=Range Complex; SINKEX = Sinking Exercise

Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-33: Proportional Impact to Bottom Habitat from Training Activities Under Alternatives 1 and 2 over Five Years

Training Areas		Impact to Hard Bottom		Impact to Intermediate Bottom		Impact to Soft Bottom		Impact to Unknown Bottom	
		MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
Northeast RC	Alternative 1	0.492165	0	1.240468	0	6.239068	0	0.000619	0
	Alternative 2	0.492208		1.240577		6.239616		0.000619	
VACAPES RC	Alternative 1	4.758210	0.865773	15.932138	2.898909	189.251318	34.434949	0	0
	Alternative 2	4.761361		15.942689		189.376659			
Northeast U.S. Continental Shelf Large Marine Ecosystem									
Lower Chesapeake Bay	Alternative 1	0	0	0.001686	0.002209	0.286530	0.375367	0.0003517	0.00046071
	Alternative 2								
James River and Tributaries	Alternative 1	0	0	1.770699	0	9.239897	0	0.2417497	0
	Alternative 2								
York River, VA	Alternative 1	0	0	0.000475	0	0.007594	0	0.000067	0
	Alternative 2								
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem									
Navy Cherry Point RC	Alternative 1	4.974258	0.078675	0.987427	0.015618	67.212644	1.063061	0	0
	Alternative 2	4.987121		0.989981		67.386452			
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
JAX RC	Alternative 1	43.309050	0.276629	30.389809	0.194110	123.251700	0.787249	0	0
	Alternative 2	43.487725	0.277932	30.515184	0.195024	123.760184	0.790956		
Cooper River, SC	Alternative 1	0	0	0	0	0.004027	0	0.0114378	0
	Alternative 2								
Port Canaveral, FL	Alternative 1	0	0	0	0	0.042262	0	0.027674	0
	Alternative 2								
Caribbean and Gulf of Mexico Large Marine Ecosystems									
Key West RC	Alternative 1	3.938953	0.211549	1.291285	0.069351	12.416125	0.666833	1.160766	0.062341
	Alternative 2								
Gulf of Mexico Large Marine Ecosystem									
GOMEX RC	Alternative 1	0.696307	0.072484	0.805531	0.083853	13.282436	1.382663	0.000229	0.000024
	Alternative 2	0.774754	0.072762	0.896284	0.084176	14.778861	1.387976	0.000255	
Abyssal Zone									
Other AFTT	Alternative 1	0.037914772	0	0.059026955	0	0.845273	0	5.789313	0
	Alternative 2								
SINKEX Area	Alternative 1	0	0	0	0	0.171338	0	0.074308	0
	Alternative 2								

Note: ac=acre; GOMEX=Gulf of Mexico; JAX=Jacksonville; MEM = Military Expended Materials; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; RC=Range Complex; SINKEX = Sinking Exercise

Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

Table F-34: Proportional Impact to Bottom Habitat from Testing Activities Under Alternatives 1 and 2 over Five Years

Training Areas		Impact to Hard Bottom		Impact to Intermediate Bottom		Impact to Soft Bottom		Impact to Unknown Bottom	
		MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)	MEM Footprint (ac)	Explosive Footprint (ac)
Northeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
Northeast RC	Alternative 1	1.641822	0	4.138102	0	20.813033	0	0.002064	0
	Alternative 2	1.719770		4.334567		21.801174		0.002162	
VACAPES RC	Alternative 1	2.110074	0.160365	7.065258	0.536956	83.925297	6.378284	0	0
	Alternative 2	2.177571	0.277178	7.291262	0.928087	86.609904	11.024366		
Northeast U.S. Continental Shelf Large Marine Ecosystem									
NUWC Newport Testing Range	Alternative 1	0.314904	0	2.656512	0	11.774893	0	0.087174	0
	Alternative 2								
Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystem									
Navy Cherry Point RC	Alternative 1	1.249154	0	0.247966	0	16.878691	0	0	0
	Alternative 2	1.259951		0.250110		17.024582			
Southeast U.S. Continental Shelf Large Marine Ecosystem and Abyssal Zone									
JAX RC	Alternative 1	10.975187	0.271418	7.701250	0.190453	31.233899	0.772418	0	0
	Alternative 2	11.420121		8.013459		32.500120			
Southeast U.S. Continental Shelf Large Marine Ecosystem									
SFOMF	Alternative 1	1.676089	0	0.015941	0	0.472885	0	0.000058	0
	Alternative 2								
Caribbean and Gulf of Mexico Large Marine Ecosystems									
Key West RC	Alternative 1	4.512035	0	1.479155	0	14.222560	0	1.329647	0
	Alternative 2	4.540391		1.488451		14.311941		1.338003	
Gulf of Mexico Large Marine Ecosystem									
GOMEX RC	Alternative 1	1.185216	0.116048	1.371131	0.13425141	22.608639	2.21367739	0.000390	0.000038
	Alternative 2	1.208126		1.397635		23.045671		0.000397	
NSWC Panama City Testing Range	Alternative 1	0.201081	2.106805	0.377795	3.958317	2.516897	26.370563	0.000036	0.000374
	Alternative 2	0.206296	2.407190	0.387595	4.522687	2.582181	30.130432	0.000037	0.000427

Note: ac=acre; GOMEX=Gulf of Mexico; JAX=Jacksonville; MEM = Military Expended Materials; NSWC=Naval Surface Warfare Center; NUWC=Naval Undersea Warfare Center; Other AFTT Area = Location outside east coast Range Complexes and other defined areas; RC=Range Complex; SINKEX = Sinking Exercise

Blue shading indicates numbers and impacts of MEM that differ between Alternatives 1 and 2

F.3 STATISTICAL AND PROBABILITY ANALYSIS FOR ESTIMATING DIRECT STRIKE IMPACT AND NUMBER OF POTENTIAL EXPOSURES FROM MILITARY EXPENDED MATERIALS

This section discusses the methods and results for calculating the probability of a direct strike of an animal from any military items from the proposed training and testing activities falling toward (or directed at) the sea surface. For the purposes of this section, military items include non-explosive practice munitions, sonobuoys, acoustic countermeasures, targets, and high-energy lasers. Only marine mammals and sea turtles will be analyzed using these methods because animal densities are necessary to complete the calculations, and density estimates are currently only available for marine mammals and sea turtles within the Study Area. The analysis conducted here does not account for explosive munitions because impacts from explosives are analyzed within the Navy Acoustic Effects Model as described in the Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing (U.S. Department of the Navy, 2018b).

F.3.1 DIRECT IMPACT ANALYSIS

A probability was calculated to estimate the impact probability (P) and number of exposures (T) associated with direct impact of military items on marine animals on the sea surface within the specified training or testing area (R) in which the activities are occurring. The statistical probability analysis is based on probability theory and modified Venn diagrams with rectangular "footprint" areas for the individual animal (A) and total impact (I) inscribed inside the training or testing area (R). The analysis is over-predictive and conservative, in that it assumes: (1) that all animals would be at or near the surface 100 percent of the time, when in fact, marine mammals spend the majority of their time underwater, and (2) that the animals are stationary, which does not account for any movement or any potential avoidance of the training or testing activity.

1. A = length*width, where the individual animal's width (breadth) is assumed to be 20 percent of its length for marine mammals and 112 percent of its length for sea turtles. This product for A is multiplied by the number of animals Na in the specified training or testing area (i.e., product of the highest average month animal density [D] and training or testing area [R]: Na = D*R) to obtain the total animal footprint area (A*Na = A*D*R) in the training or testing area. As a conservative scenario, the total animal footprint area is calculated for the species with the highest average month density in the training or testing area with the highest use of military items within the entire Study Area.
2. I = Nmun*length*diameter, where Nmun = total annual number of military items for each type, and "length" and "diameter" refer to the individual military equipment dimensions. For each type, the individual impact footprint area is multiplied by the total annual number of military items to obtain the type-specific impact footprint area (I = Nmun*length*diameter). Each training or testing activity uses one or more different types of military items, each with a specific number and dimensions, and several training and testing activities occur in a given year. When integrating over the number of military items types for the given activity, and then over the number of activities in a year, these calculations are repeated (accounting for differences in dimensions and numbers) for all military items types used, to obtain the type-specific impact footprint area (I). These impact footprint areas are summed over all military items types for the given activity, and then summed (integrated) over all activities to obtain the total impact footprint area resulting from all activities occurring in the training or testing area in a given year.

As a conservative scenario, the total impact footprint area is calculated for the training or testing area with the highest use of military items within the entire Study Area.

Though marine mammals and sea turtles may not be randomly distributed in the environment, a random point calculation was chosen due to the intensive data needs that would be required for a calculation that incorporated more detailed information on an animal's or military item's spatial occurrence.

The analysis is expected to provide an overestimation of the probability of a strike for the following reasons: (1) it calculates the probability of a single military item (of all the items expended over the course of the year) hitting a single animal at its species' highest seasonal density, (2) it does not take into account the possibility that an animal may avoid military activities, (3) it does not take into account the possibility that an animal may not be at the water surface, (4) it does not take into account that most projectiles fired during training and testing activities are fired at targets, and so only a very small portion of those projectiles that miss the target would hit the water with their maximum velocity and force, and (5) it does not quantitatively take into account the Navy avoiding animals that are sighted through the implementation of mitigation measures (for consideration of mitigation during analysis see Section 3.7.3.4, Marine Mammals, and Section 3.8.3.4, Reptiles).

The likelihood of an impact is calculated as the probability (P) that the animal footprint (A) and the impact footprint (I) will intersect within the training or testing area (R). This is calculated as the area ratio A/R or I/R, respectively. Note that A (referring to an **individual** animal footprint) and I (referring to the impact footprint resulting from the **total** number of military items N_{mun}) are the relevant quantities used in the following calculations of single-animal impact probability [P], which is then multiplied by the number of animals to obtain the number of exposures (T). The probability that the random point in the training or testing area is within both types of footprints (i.e., A and I) depends on the degree of overlap of A and I. The probability that I overlaps A is calculated by adding a buffer distance around A based on one-half of the impact area (i.e., 0.5*I), such that an impact (center) occurring anywhere within the combined (overlapping) area would impact the animal. Thus, if L_i and W_i are the length and width of the impact footprint such that $L_i*W_i = 0.5*I$ and $W_i/L_i = L_a/W_a$ (i.e., similar geometry between the animal footprint and impact footprint), and if L_a and W_a are the length and width (breadth) of the individual animal such that $L_a*W_a = A$ (= individual animal footprint area), then, assuming a purely static, rectangular scenario (Scenario 1), the total area $A_{tot} = (L_a + 2*L_i)*(W_a + 2*W_i)$, and the buffer area $A_{buffer} = A_{tot} – L_a*W_a$.

Four scenarios were examined with respect to defining and setting up the overlapping combined areas of A and I:

1. Scenario 1: Purely static, rectangular scenario. Impact is assumed to be static (i.e., direct impact effects only; non-dynamic; no explosions or scattering of military items after the initial impact). Hence the impact footprint area (I) is assumed to be rectangular and given by the product of military items length and width (multiplied by the number of military items). $A_{tot} = (L_a + 2*L_i)*(W_a + 2*W_i)$ and $A_{buffer} = A_{tot} – L_a*W_a$.
2. Scenario 2: Dynamic scenario with end-on collision, in which the length of the impact footprint (Li) is enhanced by Rn = 5 military items lengths to reflect forward momentum. $A_{tot} = (L_a + (1 + R_n)*L_i)*(W_a + 2*W_i)$ and $A_{buffer} = A_{tot} – L_a*W_a$.
3. Scenario 3: Dynamic scenario with broadside collision, in which the width of the impact footprint (W_i) is enhanced by R_n = 5 military items lengths to reflect forward momentum. $A_{tot} = (L_a + 2*W_i)*(W_a + (1 + R_n)*L_i)$ and $A_{buffer} = A_{tot} – L_a*W_a$.

4. Scenario 4: Purely static, radial scenario, in which the rectangular animal and impact footprints are replaced with circular footprints while conserving area. Define the radius (R_a) of the circular individual animal footprint such that $\pi * R_a^2 = L_a * W_a$, and define the radius (R_i) of the circular impact footprint such that $\pi * R_i^2 = 0.5 * L_i * W_i = 0.5 * I$. Then $A_{tot} = \pi * (R_a + R_i)^2$ and $A_{buffer} = A_{tot} - \pi * R_a^2$ (where $\pi = 3.1415927$).

Static impacts (Scenarios 1 and 4) assume no additional aerial coverage effects of scattered military items beyond the initial impact. For dynamic impacts (Scenarios 2 and 3), the distance of any scattered military items must be considered by increasing the length (Scenario 2) or width (Scenario 3), depending on orientation (broadside versus end-on collision), of the impact footprint to account for the forward horizontal momentum of the falling object. Forward momentum typically accounts for five object lengths, resulting in a corresponding increase in impact area. Significantly different values may result from the static and dynamic orientation. Both of these types of collision conditions can be calculated each with 50 percent likelihood (i.e., equal weighting between Scenarios 2 and 3, to average these potentially different values).

Impact probability P is the probability of impacting one animal with the given number, type, and dimensions of all military items used in training or testing activities occurring in the area per year, and is given by the ratio of total area (A_{tot}) to training or testing area (R): $P = A_{tot}/R$. Number of exposures is $T = N*P = N*A_{tot}/R$, where N = number of animals in the training or testing area per year (given as the product of the animal density [D] and range size [R]). Thus, $N = D*R$ and hence $T = N*P = N*A_{tot}/R = D*A_{tot}$. Using this procedure, P and T were calculated for each of the four scenarios, for Endangered Species Act (ESA)-listed marine mammals and the marine mammal and sea turtle species with the highest average month density (used as the annual density value) and for each military item type. The scenario-specific P and T values were averaged over the four scenarios (using equal weighting) to obtain a single scenario -averaged annual estimate of P and T. The potential numbers of exposures (T) are reported in Table F-36 through Table F-39.

F.3.2 Parameters for Analysis

Impact probabilities (P) and number of exposures (T) were estimated by the analysis for the following parameters:

1. Two action alternatives: Alternative 1 and Alternative 2. Animal densities, animal dimensions, and military item dimensions are the same for the two action alternatives.
2. Two training or testing areas: Virginia Capes (VACAPES) and Jacksonville (JAX) Range Complexes. Areas are approximately 28,000 square nautical miles (NM^2) and 50,000 NM^2, respectively. These two training and testing areas were chosen because they constitute the areas with the highest estimated numbers and concentrations of military expended materials for both alternatives, and would, thus, provide a reasonable comparison for all other areas with fewer expended materials.
3. The following types of non-explosive munitions or other items:
    - **Small-caliber projectiles**: up to and including .50 caliber rounds
    - **Medium-caliber projectiles:** larger than .50 caliber rounds but smaller than 57 millimeters (mm) projectiles
    - **Large-caliber projectiles:** includes projectiles greater than or equal to a 57 mm projectile
    - **Missiles:** includes rockets and jet-propelled munitions

- **Bombs:** Non-explosive practice bombs and mine shapes, ranging from 10 to 2,000 lbs
- **Torpedoes:** includes all lightweight torpedoes
- **Sonobuoys:** includes all sonobuoys
- **Targets:** includes expended airborne and surface, as well as mine shapes
- **Lightweight torpedo accessories:** includes all accessories that are dropped along with the torpedo (nose cap, air stabilizer, etc.)
- **Anchors:** includes blocks used to anchor mine shapes to the seafloor
- **Acoustic countermeasures:** includes aircraft deployed acoustic countermeasures
- **High Energy Lasers**: includes high energy laser weapons that are directed at a surface target
- **Expended Bathythermographs**: small sensor deployed from ships

4. Animal species of interest: The six species of ESA-listed marine mammals and the non-ESA listed marine mammal species with the highest average month density in the training and testing areas of interest. The sea turtle species with the highest average month density in the training and testing areas of interest.

F.3.3 Input Data

Input data for the direct strike analysis include animal species likely to be in the area and military items proposed for use under each of the two action alternatives. Animal species data include: (1) species identification and status (i.e., threatened, endangered, or neither), (2) highest average month density estimate each species of interest, and (3) adult animal dimensions (length and width) for the species with the highest density. The animal's dimensions are used to calculate individual animal footprint areas (A = length*width), and animal densities are used to calculate the number of exposures (T) from the impact probability (P): T = N*P. Military items data include: (1) military items category (e.g., projectile, bomb, rocket, target), (2) military items dimensions (length and width), and (3) total number of military items used annually.

Military items input data, specifically the quantity (e.g., numbers of bombs, and rockets), are different in magnitude between the two action alternatives. All animal species input data, the military items identification and category, and military items dimensions are the same for the two alternatives, only the quantities (i.e., total number of military items) are different.

F.3.4 Output Data

Estimates of impact probability (P) and number of exposures (T) for a given species of interest were made for the specified training or testing area with the highest annual number of military items used for each of the two action alternatives. The calculations derived P and T from the highest annual number of military items used in the Study Area for the given alternative. Differences in P and T between the alternatives arise from different numbers of events (and therefore military items) for the two alternatives.

Results for marine mammals and sea turtles are presented in Table F-36 through Table F-39.

Table F-35: Estimated Representative Marine Mammal Exposures from Direct Strike of a High Energy Laser by Area and Alternative in a Single Year

Northeast United States Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area				
VACAPES Range Complex				
Species	Training		Testing	
	Alternative 1	Alternative 2	Alternative 1	Alternative 2
North Atlantic Right Whale	0.000000	0.000000	0.000000	0.000000
Sei Whale	0.000000	0.000000	0.000001	0.000001
Fin Whale	0.000001	0.000001	0.000005	0.000005
Blue Whale	0.000000	0.000000	0.000000	0.000000
Sperm Whale	0.000002	0.000002	0.000010	0.000010
Short Beaked Common	0.000007	0.000007	0.000140	0.000140

Note: VACAPES=Virginia Capes

Table F-36: Estimated Representative Sea Turtle Exposures from Direct Strike of a High Energy Laser by Area and Alternative in a Single Year

Northeast United States Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area				
VACAPES Range Complex				
Species	Training		Testing	
	Alternative 1	Alternative 2	Alternative 1	Alternative 2
Loggerhead Sea Turtle	0.000008	0.000008	0.000136	0.000136

Note: VACAPES=Virginia Capes

Table F-37: Estimated Representative Marine Mammal Exposures from Direct Strike of Military Expended Materials by Area and Alternative in a Single Year

Species	Training		Testing	
Northeast United States Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area				
VACAPES Range Complex				
	Alternative 1	***Alternative 2***	***Alternative 1***	***Alternative 2***
North Atlantic Right Whale	0.000061	0.000061	0.000024	0.000024
Sei Whale	0.000256	0.000256	0.000098	0.000098
Fin Whale	0.001259	0.001259	0.000486	0.000487
Blue Whale	0.000003	0.000003	0.000001	0.000001
Sperm Whale	0.003051	0.003052	0.001171	0.001171
Short Beaked Common Dolphin	0.068821	0.068835	0.025966	0.025974
Southeast United States Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area				
JAX Range Complex				
Species	***Training***		***Testing***	
	Alternative 1	***Alternative 2***	***Alternative 1***	***Alternative 2***
North Atlantic Right Whale	0.000329	0.000340	0.000568	0.000568
Sei Whale	0.000023	0.000024	0.000040	0.000040
Fin Whale	0.000025	0.000025	0.000042	0.000042
Blue Whale	0.000002	0.000002	0.000003	0.000003
Sperm Whale	0.000077	0.000079	0.000132	0.000132
Atlantic Spotted Dolphin	0.011027	0.011409	0.019204	0.019210

Note: JAX=Jacksonville; VACAPES=Virginia Capes

Table F-38: Estimated Representative Sea Turtle Exposures from Direct Strike of Military Expended Materials by Area and Alternative in a Single Year

Species	Training		Testing	
Northeast United States Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area				
VACAPES Range Complex				
	Alternative 1	***Alternative 2***	***Alternative 1***	***Alternative 2***
Loggerhead Sea Turtle	0.065726	0.065740	0.032481	0.024822
Southeast United States Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area				
JAX Range Complex				
Species	***Training***		***Testing***	
	Alternative 1	***Alternative 2***	***Alternative 1***	***Alternative 2***
Loggerhead Sea Turtle	0.038939	0.040289	0.067786	0.067810

Note: JAX=Jacksonville; VACAPES=Virginia Capes

F.4 Poisson Probability of Direct Vessel Strike with Marine Mammals

In order to assess the probability of a Navy vessel striking a marine mammal during future training and testing activities, the Navy considered data on vessel usage within the Study Area (steaming days) and past ship strike records from the time period beginning in 2009. The Navy determined that data beginning in 2009 would be the most representative for predicting the potential for future vessel strikes, because this year coincided with when the Navy's mitigation, monitoring, and reporting requirements became standardized across the Fleets with the issuance of Marine Mammal Protection Act (MMPA) permits for sonar and explosive usage in at-sea Navy ranges.

Between 2007 and 2009, the Navy developed and distributed additional training, mitigation, and reporting tools to Navy operators to improve marine mammal protection and to ensure compliance with upcoming permit requirements. In 2007, the Navy implemented the Marine Species Awareness Training, which is designed to improve the effectiveness of visual observations for marine resources, including marine mammals and sea turtles. In subsequent years, the Navy issued refined policy guidance regarding marine mammal incidents (e.g., ship strikes) in order to collect the most accurate and detailed data possible in response to a possible incident. For over a decade, the Navy has implemented the Protective Measures Assessment Protocol software tool, which provides operators with notification of the required mitigation and a visual display of the planned training or testing activity location overlaid with relevant environmental data (see Section 5.1, Introduction).

Similar mitigation, reporting and monitoring requirements have been in place since 2009 and are expected to continue into the future. Therefore, the conditions affecting the potential for ship strikes are the most consistent across this time frame. As a result, data from the past eight years (i.e., 2009 to 2016) are used to calculate the probability of a Navy vessel striking a whale during proposed training and testing activities in the Study Area. The year 2009 was selected because it is the beginning of programmatic permitting within the Atlantic and Pacific oceans; acknowledges advances in Navy marine species awareness training and overall enhanced sensitivity to marine resource issues in general; and is the first year of the codification of multiple marine species mitigation measures including specific measures to avoid large whales by 500 yards so long as it is safe for navigation. Additionally, due to better data and knowledge of species presence, the period beginning in 2009 is more representative of current and reasonably foreseeable marine mammal occurrence in AFTT. The level of vessel use and the manner in which the Navy trains and tests in the future is expected to be consistent with this time period.

In the AFTT Study Area, there were a total of three reported Navy vessel whale strikes from 2009-2016. During this same time period there were a total of 39,040 steaming days of vessel use within the Study Area. Therefore, there was an average strike rate of 0.00008 strikes per steaming day. Based on the annual average from 2009-2016, the Navy estimates that 24,400 steaming days will occur over any five-year period associated with an MMPA authorization. These values were used to determine the rate parameters to calculate a series of Poisson probabilities (a Poisson distribution is often used to describe random occurrences when the probability of an occurrence is small, e.g., count data such as cetacean sighting data, or in this case strike data, are often described as a Poisson or over-dispersed Poisson distribution).

In modeling strikes as a Poisson process, we assume this strike rate for the future and we use the Poisson distribution to estimate the number of strikes over a defined time period in the future:

$$P\left\langle n \middle| \mu \right\rangle = \frac{e^{-\mu} \bullet \mu^{n}}{n!}$$

P($n|\mu$) is the probability of observing *n* events in some time interval, when the expected number of events in that time interval is *u*. As stated previously, the Navy estimates that 24,400 steaming days could occur; and given a strike rate of 0.00008 strikes per steaming day the expected number of strikes (μ) over a five-year period is 1.875. To estimate zero occurrences (in this case, no whales being struck), the formula P(0)=e-$^{\mu}$ would apply. Assuming the estimated number of strikes over a five-year period, the equation yields a value of P(0) = 0.153. The resulting probabilities of one through five strikes over a five-year period are:

1. P(1) = (0.153 * 1.875^1)/1 = 0.288
    - *29 percent probability of striking one whale in a 5-year period*
2. P(2) = (0.288 * 1.875^ 2)/2 = 0.270
    - *27 percent probability of striking two whales in a 5-year period*
3. P(3) = (0.270 * 1.875^ 3)/6 = 0.168
    - *17 percent probability of striking three whales in a 5-year period*
4. P(4) = (0.168 * 1.875^ 4)/24 = 0.079
    - *8 percent probability of striking four whales in a 5-year period*
5. P(5) = (0.079* 1.875^ 5)/120 = 0.030
    - *3 percent probability of striking five whales in a 5-year period*

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